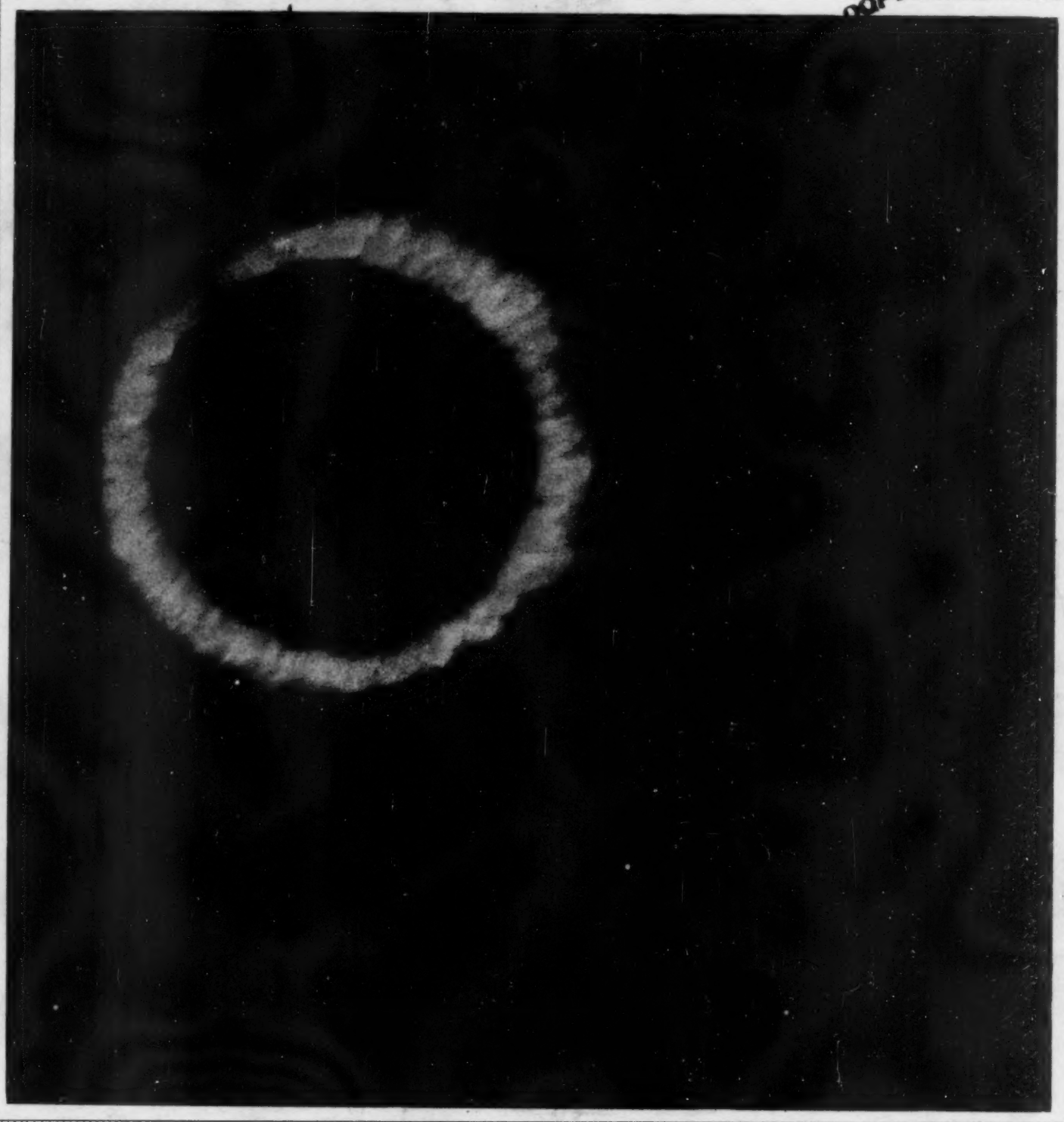
SCIENTIFIC AMERICAN

APRIL 1925



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The power company load dispatcher can talk reliably over wires carrying 100,000 volts or more.

The voice that rode 100,000 horse power

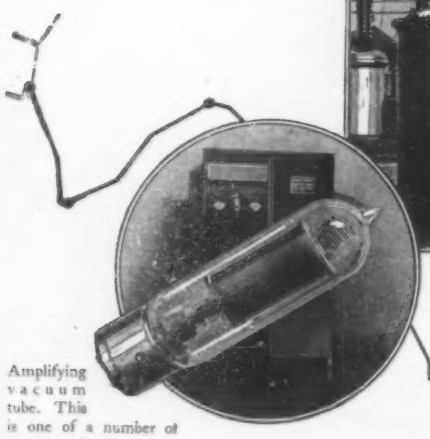
RIDING astride horse power enough to run an industrial city, came the voice over the wire, "Bad storm put Mill City line out of commission, tie in Springvale circuit."

Now electric light and power company operators can telephone over their own power transmission lines carrying thousands of horse power. Yet they talk and signal with ease with a few thousandths of a horse power by the use of the Western Electric Power Line Carrier Telephone Equipment.

It is the most satisfactory means yet devised for communicating between the stations of companies which cover a wide area and where commercial telephone facilities are not available. It is an important aid in emergency and it helps maintain service twenty-four hours a day.

Here is a worthy newcomer to the long list of products manufactured by the world's largest maker of telephones.

Not a giant chessman. This coupling condenser gives the voice currents safe conduct from telephone instruments to power line.



Amplifying vacuum tube. This is one of a number of vacuum tubes used in the transmitter circuits.

On a cross country power line any station can talk with any other—with Western Electric equipment.

Western Electric

SINCE 1869 MAKERS OF ELECTRICAL EQUIPMENT

NORDICS

MR. Hopkins' article, "Which Races Are Best?" in the February issue has brought us many brickbats and a few bouquets. Most of the brickbats come from defenders of the idea that the good things of the world belong to good Nordics. This is all right. We expected it.

But among the protests is one about which we are sorry. Dr. Henry Fairfield Osborn of the American Museum of Natural History feels that our use of an illustration credited to that Museum may be taken to imply an approval of the article. We hasten to assure our readers that this is not the case. The article was not submitted to Dr. Osborn. We alone are responsible.

To the kindly tossers of our brickbats we can say only that we still believe in Mr. Hopkins' conclusions. We intend to stick to them. But both sides have a right to be heard. We have asked some contrary minded persons for their views. Probably we will publish them.

BOILER

FROM England comes the report of a new steam boiler in which a flame of mixed oil and air is burned inside the water. The air keeps the oil alight. Great things are claimed, including the delivery of even more power than was contained, inherently, in the oil.

To us, this looks just a little watery. Maybe it is true, but the flavor of old delusions of perpetual motion clings to it. We are investigating. When the full truth comes out we will print it. Meanwhile, in case the invention becomes, as is possible, the subject of newspaper reports, you may look forward to finding the facts in our columns so soon as we can make certain what they are.

ROTORS

ANOTHER invention that we are watching with interest is the rotor ship of Herr Flettner, already described in our February issue. This ship has had, recently, a trial trip across the North Sea. Performance was reasonably good, but not good enough, as yet, to convince us that world shipping is to be revolutionized.

The speed was not remarkable. Some mechanical troubles are reported—which is, of course, perfectly natural with so new an invention. The main point is not yet touched. This is: What will the ship do in a real storm?

INVESTMENTS

IN this issue we dive off into a new river. We are going to have a department for investors. More money is lost every year in bad investments than in any other form of amusement. If the basic scientific facts of industries were better known there is every reason to hope that the annual crop of easy-marks would decrease. We are going to try to do our bit.

When you have read the first issue of the new department—assuming, of course, that you do read it—drop us a line and tell us whether you like it. And if not, why not?

In This Issue

All About the Eclipse

Twenty million people saw the eclipse on January 24th. The scientists accumulated the best data ever obtained. The famous color-photograph of the corona is on the cover of this issue. Details of other observations are on pages 221 to 227.

That Mysterious Diamond Ring

Some people are sure that they saw it just as the eclipse was over. Others thought it was just at the beginning. Still others maintain that it was never visible at all. The truth about it and the reasons for what everybody saw are explained by Professor Russell on pages 221-222.

The Margery Case Is Over

Few cases of supposed psychic phenomena have agitated believers and disbelievers alike as much as has the Margery case, unearthed by our Psychic Investigation. The Committee has rejected the case. Full statements will be found on page 229.

America's Burning Shame!

That is what Chief Kenlon calls the staggering annual fire loss of the United States. Do you want *your* house to be the next to go up in smoke? Then go home and do something to prevent it. On page 230 Chief Kenlon tells you what to do.

Just How Defenseless Is Our Country?

General Mitchell says that New York City is at the mercy of an enemy air fleet. Hawaii and the Philippines would fall instantly, he believes, before the attack of any strong power. We wonder. The General is sincere but there is another side to the question. Read Mr. Walker's editorial on page 228.

MORE THAN ONE HUNDRED PICTURES

Complete table of contents will be found on page 288

For Next Month

Shall We Abolish the Speed Laws?

What automobile speed is safe? Nobody knows. Our automobile expert, Mr. Slauson, has decided that all the speed-limit laws are wrong. He has a revolutionary suggestion, one that may change all traffic laws. He will describe it in the May issue, out April 20th.

The Truth About Muscle Shoals

Is the war-time power project at Muscle Shoals a vast exploded bubble or is it still a national asset? Few public problems have been so much befogged as this. The voters must know. Mr. Lane of our staff is making an investigation. He will report in the next issue.

Just How Inferior Is Our Navy?

Not a bit, says our own Mr. Walker, whose reputation as a naval expert is world-wide. Our fleet is as strong as the British. We were not cheated at the disarmament conference. Complete comparisons in our May issue, on sale April 20th.

Other articles on Atoms, the Slow Crumbling of St. Paul's Cathedral, Burning Coal Like Gas, Radio, the Story of Steel, the Curious Lives of Ants, a New Department for Inventors.

MORE THAN ONE HUNDRED PICTURES

¶ ***Do you want your ideas to count? Then know the facts about Muscle Shoals, about our Navy, about auto traffic.***

The next issue and two more will cost you only one dollar. How about it?

MONEY

WE are now at work on a motion picture of the eclipse. It will be a strictly scientific picture. We think it will be interesting and amusing too. There is an announcement about it on page 227.

You may be able to earn a hundred dollars by telling us what you think of this idea and of how to make scientific movies still better than this one. Also, you will do us a real service. Page 227 tells all about it.

Even if you do not wish to compete for the prize, write us your criticism of the movie anyway.

THANKS

OUR best thanks are due to the two thousand or more persons who helped us observe the eclipse. Seven pages of eclipse reports will be found in this issue. Others will follow in later issues, as rapidly as possible.

Conflicting newspaper reports, which some investigators rushed too rapidly into print, have spread the belief that the radio eclipse investigation led to no valuable results. This is very far from true, as the article on page 224 of this issue will make evident.

Still more important results are in incubation. It is quite possible that the eclipse data will make us, for the first time, really sure about the path of radio waves around the earth.

EMANATIONS

RECENT reports from London are being cited in support of the Abrams delusions. It is said by Abrams enthusiasts that our investigation of them has been "shown up."

Well, that would be interesting, if true, although we imagine we could survive it. But it is not true. Here are the facts.

Dr. W. E. Boyd, of Glasgow, has devised an apparatus with which he identifies certain drugs by supposed "emanations." In a series of tests by scientific men, Dr. Boyd succeeded quite well.

A living human subject is used, as one was by Dr. Abrams. Here the affinity to Abrams ceases. The apparatus is different. There is no claim to diagnose or treat disease. Both Dr. Boyd and the experimenters disclaim any support to E. R. A.

The experiments are interesting. Our present belief is that some honest mistake is probable. But we may be wrong. Dr. Boyd really may have discovered a new property of matter. If so, that fact will appear as the experiments go on.

APPRECIATION

SOMEBODY has stuck the Query Editor of the *Denver Post*. Replying to an inquiry from "W," of Denver, as to the "chemical used for making the pressure in fire extinguishers," the Editor throws up his hands. "I'll give up," he writes, "Write the Scientific American, New York City."

Thanks, friend, for the ad. We hope "W" did write to us and we hope we told him what he wanted to know.

EIGHTY-FIRST YEAR

SCIENTIFIC AMERICAN

THE MONTHLY JOURNAL OF PRACTICAL INFORMATION

NEW YORK, APRIL, 1925

Two Outstanding Features of the Eclipse

An Account of the Origin of the Shadow Bands and of the Famous Diamond Ring

By Henry Norris Russell, Ph.D.

THE long-expected eclipse has passed into history and fortune has done what she could to compensate for her vagaries in California two years earlier. The country near the coast, where practically all the observers and the majority of the lay spectators were to be found, had perfect weather. In spite of unfavorable chances all went well.

It is too early, at the date of this writing, to speak of the scientific results of the eclipse. The very success of the observations will make it a long task to work out their full implications. But various matters, which have excited widespread interest, and were but lightly touched upon in the discussions written before the event, may well be taken up here and now.

As a spectacle the eclipse of 1925 could hardly have been surpassed. The spotless sky, the clear winter air, the snow-clad landscape, the group of bright planets close to the sun, and, above all, the brilliant and beautifully formed corona, combined to make the occasion most memorable. The corona, with its long pointed extensions in the direction of the sun's equator and curved streamers near its poles, was rather of the type associated with sun-spot minimum—which is not remarkable, as the new spot-cycle is not far advanced. The small number and inconspicuous character of the prominences was also what might have been anticipated under the circumstances.

The Glorious Sunset Glow

But some other features of the eclipse were unexpected. The amount of light during totality was, by common consent, unusually great. This may have been due in part to the clearness of the air and the brightness of the corona, but it probably may be attributed mainly to the deep snow, which reflected the corona light, and, what is more important, a flood of light from the regions, nowhere much more than fifty miles away, where the sun was still shining. The reddy or orange glow, like a sunset all around the horizon, reported by many observers, was due to this diffused sunlight and was probably unusually conspicuous at this eclipse.

Another very striking feature was the great prominence of the shadow bands. As the writer saw these at New Haven, they first appeared some five minutes before totality as narrow, pale, flickering strips of shade, two or three inches wide and six or eight apart. As the light faded they became more and more prominent. During the last minute of sunlight everything was covered with a mad maze of narrow, dark, flickering, squirming bands, so conspicuous that they must have attracted instant attention from any one who looked at the ground. Indeed there was hardly anything more weird in the whole unearthly sequence than the appearance in the growing obscurity of these thousands of writhing serpents of shadow. After totality, they were much less remarkable.

The Cover of This Issue

On the cover of this issue of the Scientific American we reproduce the famous color photograph of the sun's corona taken by Mr. Edward Hewitt at the Scientific American observing station, Easthampton, Long Island. This remarkable photograph has not been retouched or corrected in any way.

It is reproduced by the offset process of lithography. We wish to acknowledge with our best thanks both the permission of Mr. Hewitt to use the photograph and the cooperation of the lithographic department of the Andrew H. Kellogg Company in making this reproduction directly from the original.

Being the first attempt of its sort, the taking of this color photograph was very much of an experiment. One characteristic of the plates and camera used turned out, in fact, to be a little less than perfect. The sun's image on the plate was too small when compared with the sizes of the individual color grains in the sensitive emulsion. This is why the reproduction on the cover shows a somewhat fuzzy edge for the disk of the moon.

Many persons who saw the eclipse may feel that the colors of this reproduction contain too much red and orange. To most observers the corona looked bluish white. In this instance, however, it is the human eye which is wrong, not the camera. The red, orange and yellow colors were actually there but, because of a well-known phenomenon of fatigue of the retina of the eye by previous strong light, the reddish and yellowish colors were seen only by those observers who had kept their eyes in darkness for some minutes ahead of totality.

Reports from observers at different stations vary widely. Some saw the bands only two or three inches apart; others a foot or more. Some found them nearly stationary except for the flickering just mentioned; others saw them drifting as fast as a man could run. Yet all these apparently conflicting stories confirm the theory of their origin which is now generally held.

There can be little doubt—none at all, so far as the writer understands the evidence—that these shadow bands are the actual shadows of streaks of irregular density in the air. Anyone can see shadows of similar nature when the rays of the rising or setting sun cross a room above a radiator or a hot-air register and fall on the opposite wall. The rising stream of warm air casts a definite shadow which dances and flickers just as the shadow-bands did, so much so that this analogy seems to have occurred spontaneously to hundreds of people.

Shadow Bands Originate in Air

What causes the shadows is, of course, the unequal refraction of light by the streaks of warmer and cooler air. Only when the differences of temperature are considerable does the effect ordinarily become conspicuous but our atmosphere is full of similar optical turbulence at all times. The astronomer knows this only too well, for it spoils his telescopic images and prevents him from seeing such things as fine details on the planets on the great majority of clear nights, at least in our part of the world.

But, if this explanation is true, why do we not see shadow bands on sunlit snow every day? If the sun were a mere star-like point there is no doubt that we would see the bands often. But actually the sun shows a large disk. Shadows cast by the uneclipsed sun are far from sharp except close to the obstacles that cast them. The trunks and the nearer branches of trees cast fairly definite shadows but the fine twigs, fifty feet above the ground, cast practically no shadows at all—they are so spread out and weakened that we can hardly detect them.

How much more, then, should this happen in the case of the streaks of denser or more rarified air hundreds or thousands of feet above our heads? Only when the disappearing sun is reduced to a narrow crescent do the shadow bands appear. The steady and conspicuous increase in their prominence as the crescent narrows is enough by itself to indicate their origin.

It is now obvious why observers in different places,

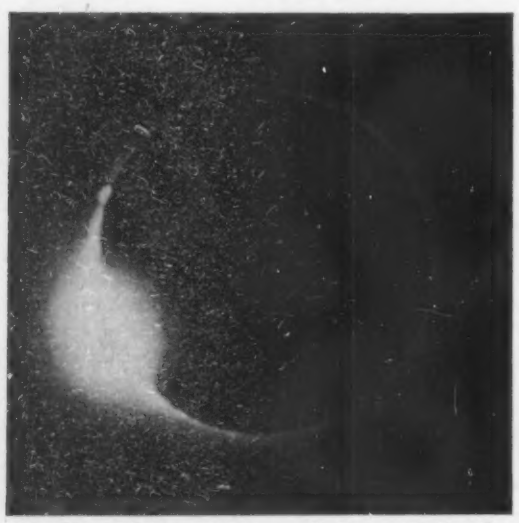
P. and A. photos

Amateur observers gathered at points of vantage to view the spectacle

with quite different air currents over their heads, saw shadow bands of such different types. The disturbances which cast the shadows may in some cases be close to the earth's surface, in others a mile or more high, or both may appear together.

On the present occasion, the low altitude of the sun and the long air-path of its rays, and, above all, the mantle of snow, forming an ideal surface upon which to see the bands, may account for their unusual conspicuousness. Study of the observations which have been recorded by hundreds of people will tell us, doubtless, much concerning the air-currents in which these bands find their origin, but there is no justification at all for speaking of them as "mysterious" or "unexplained."

Another phenomenon of the eclipse which attracted widespread notice, particularly in New York City and at other points near the limits of totality, was the "diamond ring," phase, occurring just before and after totality. The whole circle of the dark moon was visible surrounded by a narrow ring of faint, yellowish light. Upon this, at one side, blazed a dazzling spot like a great luminous jewel.



The diamond ring as photographed near Newburgh, New York, by Mr. W. F. C. Ferguson of the Department of Physics, Washington Square College, New York University

The interpretation of this singular and beautiful spectacle is really quite simple. The outer parts of the corona, including all the streamers, are so faint that the first flash of illumination of the sky by the returning sun drowns them out. But the inner corona, for fifty or a hundred thousand miles above the sun's surface, is very much brighter and can be seen for some little time after totality ends; for fully half a minute if the air is clear. The light of the inner corona is yellowish, unlike the pure pearly white of the streamers. Seen through the blue foreground of the sky it resembles nothing more closely than a golden ring. The "diamond" is, of course, the tiny strip of the photosphere—the sun itself—which first emerges from behind the moon.

The Secrets of the Diamond Ring

For stations near the central line, at which the sun came squarely out from behind the moon, the duration of this phase of the eclipse was but a few seconds. For observers near the limit of the shadow, where the sun came out very obliquely, the "diamond ring" remained visible longer. It may have been seen from points several miles outside the limit of totality, although only by observers who abandoned the heavy shade-glasses which are so necessary during the earlier phases.

Many of the thousands who saw this phenomenon appear to have been puzzled by one thing. The dazzling spot of light appeared nearly circular, extending out onto the blue sky and inward over the moon's disk.

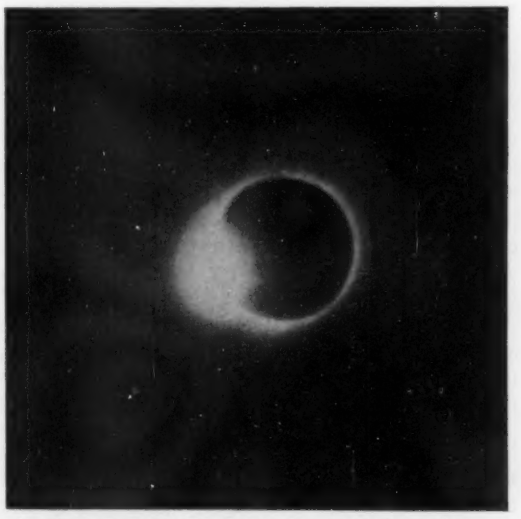
This appearance was seen directly by many, photographed by others and seen on the ground-glass of cameras by others still. Yet any one trained in optics can have no hesitation at all in interpreting it as an illusion—an example of *irradiation*.

All brilliant sources of light look bigger than they really are. A familiar example is an unprotected arc light. Viewed from a hundred feet away this looks like a luminous ball surrounded by diverging rays and probably ten times bigger than the tiny speck which it really is when seen from such distance. Both the ball of light and the rays are "all in our eyes," the first produced by the spreading of excitation from one element of the retina of the eye to those near by and the second by the scattering of a small fraction of the light by minute and harmless specks within the eyeball.

The narrow, linear, returning shred of the sun is far brighter than an arc light. Its rays fall upon an eye adjusted to the darkness which prevails during totality. The conditions are perfectly adapted, therefore, to call forth a maximum display of irradiation and to make the short and narrow line of dazzling light look like a larger globe.

The grained surface of a photographer's ground glass and the photographic film itself are even more given to this diffusion of light than is the human eye, so that irradiation affects the photographed, as well as the visual, image.

In the admirable painting of the eclipse of 1923 by Howard Russell Butler, the first speck of the returning sun is shown surrounded by a golden glow of just this sort. The distinguished artist, perfectly aware of the nature and origin of irradiation, but true to the fundamental principle that art must represent nature as it appears to the human eye, painted the thing as men see it—and did rightly.



Another photograph of the diamond ring taken at Waverly, New York, by Mr. E. G. Warner and supplied to us through the courtesy of Mr. T. P. Yates of that city

Why Was the Moon Late?

How the Efforts of Many Volunteer Observers Contributed to the Precise Measure of the Moon's Position in Space

ONE of the features of the eclipse which has attracted the widest attention is the fact that the moon was about five seconds late. To the general public it seemed wonderful that the astronomers could predict an eclipse so accurately—as, indeed, it is. The astronomers were disappointed at being wrong at all. A discrepancy even so small as five seconds is something that needs study.

If the motions of the earth and the moon relative to each other and to the sun were absolutely uniform there would be small possibility of any error in predicting an eclipse. The eclipses of 2025 A. D. or of 4025 A. D. could be predicted not only within an error of five seconds but within an error as small as can be observed.

But, fortunately for the interesting uncertainty of astronomy, the heavenly bodies are not so completely in thrall as this. The moon is afflicted with a wabble. Its orbit around the earth is not a simple and invariable circle but is a very complicated interlacing curve the exact shape of which is affected by a number of minor forces some of them not yet identified.

The determination of the precise, actual path of the moon through space is not by any means an easy task. We cannot reach out with a yardstick and measure its position from day to day. Accordingly, an eclipse is a precious opportunity to measure the exact place of the moon. At the second of totality the sun, the earth and the moon are exactly in a straight line. The instant at which this happens, when compared with the instant at which it was calculated to happen, provides an invaluable check on the calculations of the astronomers.

Public Helped Fix Edge

A similar check is provided, at the same time, by the measurement of the exact place on the earth's surface where the moon's shadow falls. Hence the emphasis placed, at the recent eclipse, upon the determination of these two facts: the exact time of the eclipse and the exact limits of the path of the shadow.

The fixing of the edges of the shadow was a task in which the public could help and did help. As a result of the request of the American Astronomical Society, thousands of persons have sent in the coupons recording whether the eclipse was or was not total at their stations.

These reports are now being studied. Final information is not yet at hand. It appears, however,

Carpenter-Goldman Laboratories, Inc.

TIMING THE ECLIPSE

Mr. J. B. Place, telegraph operator at Easthampton

that the area actually covered by the total shadow at the time of the eclipse was both a trifle narrower and a trifle farther north than had been calculated.

As to the time, the eclipse was undoubtedly late; apparently by about five seconds. Through the cooperation of the American Telephone and Telegraph Company—furnished without charge as a service to American science—five observing stations were linked together by special telegraph and telephone lines so that the exact second of the beginning of totality at each station could be recorded on a single chronograph and compared.

The westernmost of these stations was at Buffalo, New York, in charge of Professor Harlow Shapley of Harvard University. Professor Shapley had bad luck. The sky was cloudy. A precise determination of the time at which totality began could not be obtained. The next station was at Ithaca, New York, in charge of Professor S. L. Boothroyd. Here the beginning of totality was five seconds late. At Poughkeepsie, New York, at the Observatory of Vassar College, where Dr. Caroline Furness was the observer in charge, the delay of the eclipse was recorded as 2.7 seconds. At Yale University, New Haven, Connecticut, Mr. H. Clyde Snook, recorded the beginning of totality as 5.7 seconds late. Finally, at the station of the Scientific American at Easthampton, Long Island, totality was recorded as begining 5.5 seconds later than was calculated.

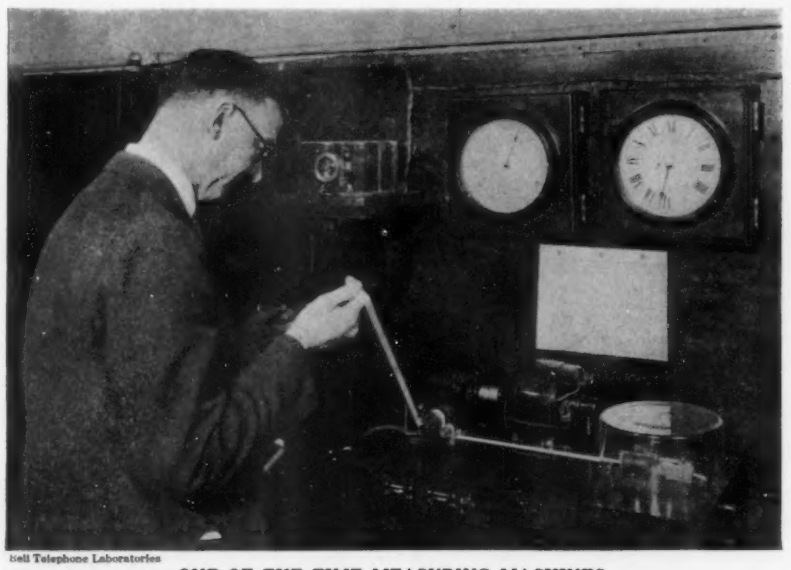
Eclipse Timed by Telegraph

At the instant of totality at each station, a signal was sent over the telegraph wire. These signals were recorded automatically on the tapes of accurate time-measuring machines at the Bell Telephone Laboratories in New York City and at Yale University. The seconds of delay, as given above, are those computed from these machines.

Professor E. W. Brown, of Yale University, is now studying the records of the time and the path. "We may assume," he writes us, "that the eclipse was five seconds late, and astronomers want to know why. Two of these five seconds have already been explained by the fact that the sun arrived at the necessary spot in the heavens at a time slightly different from that used in the prediction. The fact that the band of totality was perhaps half a mile or so narrower than that predicted shows that the diameter of the moon assumed in the calculations was too large or that the assumed diameter of the sun was too small or perhaps both. This would account for one or two seconds more.

"It follows that the much abused moon may not be responsible for more than two seconds of the discrepancy. So the knowledge gained from public observations of the northern and southern edges of the shadow path has already given valuable information to science."

¶ *Professor Brown is continuing his study of the records. As further results are announced they will be reported in the Scientific American.*



Bell Telephone Laboratories

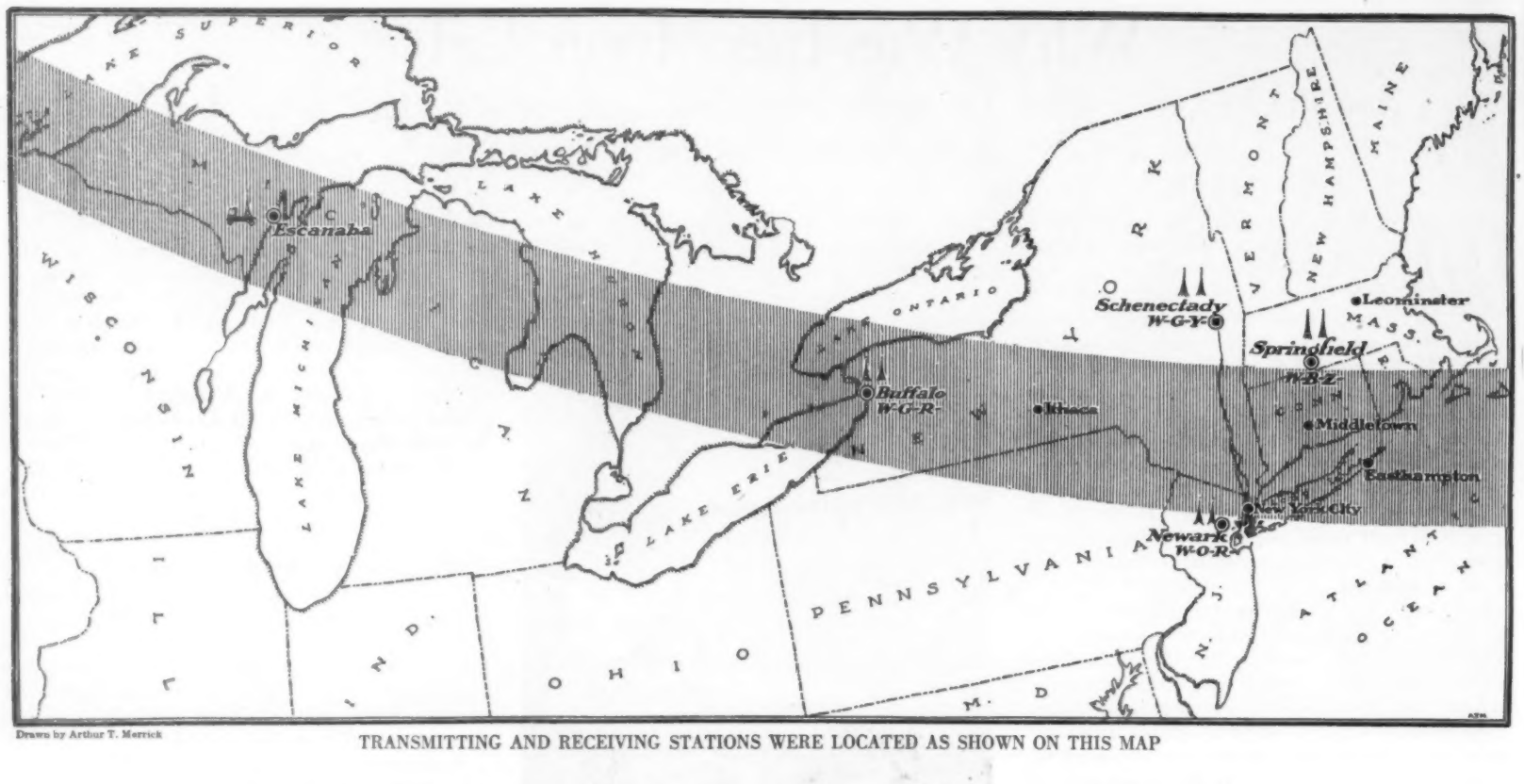
ONE OF THE TIME MEASURING MACHINES

Mr. J. W. Horton of the Bell Telephone Laboratories inspects his chronograph record

New York Edison Company

DETERMINING WHETHER THE ECLIPSE WAS TOTAL

The New York Edison Company used electric photometers to fix the shadow edge



Drawn by Arthur T. Merrick

TRANSMITTING AND RECEIVING STATIONS WERE LOCATED AS SHOWN ON THIS MAP

The Effects of the Eclipse on Radio

A Preliminary Report of the Comprehensive Observations Made By Our Own Collaborators and Others

By Alfred P. Lane and F. X. Walsh
of the Scientific American Eclipse Party

THE eclipse was unquestionably the greatest experiment ever made in radio science. It was a great success. It will be months before we can analyze all of the data and decide upon the conclusions which are to be set down as certain. The desk of every co-operating engineer is piled high with thousands of reports from the collaborating listeners and from the laboratories, broadcasting stations and individual scientists who conducted their own investigations. To digest all this data within four weeks is humanly impossible, and four weeks is all the time we have had, at this writing, since those wonderful two minutes of totality came and went.

Something in Air Affects Radio

Nevertheless, it is possible to say already that the facts learned will be of the utmost importance to the theories of radio transmission, and possibly to the practice of radio as well. We have always *assumed* that the sun affects radio; now we *know* that it does. We have had a rather uncertain belief in some sort of an ionized layer high up in the earth's atmosphere—the so-called Heaviside Layer. Now we know that something in the upper air really does affect the progress of the radio waves.

This something may not be exactly what we have conceived as the Heaviside Layer. Our theories may need modification. But we have obtained, it is probable, the data which will enable us to make these modifications; to formulate new theories which are closer to the truth.

The radio investigations attempted during the eclipse divide, more or less clearly, into three parts. First, a number of radio engineers, headed by Mr. Greenleaf W. Pickard, organized a network of instrumental receiving stations at Ithaca, New York; Leominster (about sixty miles west of Boston), Massachusetts; Middletown, Connecticut; and New York City. The last named station was at the laboratory of the Radio Corporation of America, in charge of Dr. Alfred N. Goldsmith.

At each of these stations a running record was made showing, instant by instant, the received field strength of two or more of the broadcasting stations: WGR, WGY, WBZ and WEAF. At New York City a record was made also of the reception from 2XI, the short-wave station of the General Electric Company at Schenectady, New York. These records ran for several hours before and after totality. Comparison records were made on preceding and following days.

In addition to this network, instrumental records of one or more broadcasting stations were made at the Bureau of Standards, Washington, D. C.; at the laboratories of the General Electric Company, Schenectady; by Mr. David Grimes, at Waterbury, Connecticut; by Mr. Albert Murray at Newport, Rhode Island; by Professor Howard M. Fry of Lehigh University, Bethlehem, Pennsylvania; by the laboratories of F. A. D. Andrea, Inc., in New York City; by Mr. Joseph P. Bruell, in Brooklyn, New York; by the Scientific American (as described below) and by others.

The second group of observations included the tests made by the radio amateurs, using waves within the regular amateur band. Twenty amateur transmitters were on the ether and many other amateurs were told off to listen to one or more of these transmitting stations and to record any changes of intensity. These tests were organized by the American Radio Relay League.

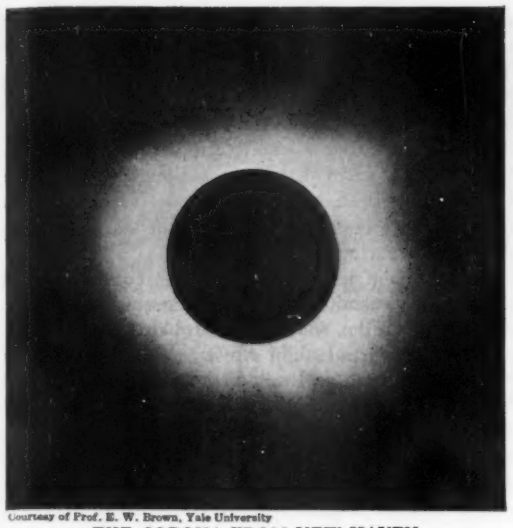
The third part of the radio work was that with which the Scientific American was especially concerned, the organization of tests by the radio listeners who volunteered to help. More than two thousand such listeners registered with us or with one or the other of the co-operating broadcasting stations. The majority of these listeners have sent in reports. In addition, we have received reports from several hundred persons who failed to hear of the tests in time to register but who listened on the morning of the eclipse and made records of what they heard.

We are deeply grateful to all of these collaborators. They have sent us data of great value. We hope that the knowledge of a good job well done will prove to them a satisfactory reward for their effort and time.

Stations Transmitted Special Copy

We are grateful, too, to the four broadcasting stations which assisted, so willingly and competently, in our tests. These were WGR, the Federal Telephone Manufacturing Company, Buffalo, New York; WGY, the General Electric Company, Schenectady, New York; WBZ, the Westinghouse Electric and Manufacturing Company, Springfield, Massachusetts; and WOR, L. Bamberger and Company, Newark, New Jersey. At each of these stations a special eclipse program was transmitted beginning at 8:00 A.M. Eastern Standard Time, on the morning of the eclipse. At 8:45 A.M. each station began reading special copy, each word of which was carefully timed at the transmitting stations, so that we now know the exact second at which each spoken word went out on the ether.

The co-operating listeners had been divided previously into groups, each group instructed to listen to



Courtesy of Prof. E. W. Brown, Yale University

THE CORONA FROM NEW HAVEN

This photograph was made by the star-catalogue camera of Yale University at New Haven, Connecticut

one or the other of these four stations. The listeners set down in their reports the word of the read copy at which the signals appeared to fade or to increase. Thus we have an exact time-check on all the changes that occurred, without depending on the accuracy of individual watches or clocks. The reading of the special timed copy continued until 9:30 A.M., thus covering a period of forty-five minutes—about twenty minutes before the total part of the eclipse began, ten minutes during the eastward passage of the spot of totality, and fifteen minutes after totality was over.

In addition to our own tests, the Zenith Radio Corporation of Chicago, Illinois, sent their portable broadcasting station to Escanaba, Michigan, almost at the center of the path of totality, and transmitted programs for two evenings in advance of the eclipse as well as on the morning of the eclipse. Many listeners reported on the reception of this station and their reports have been kindly forwarded to us by the Zenith Company. Another portable station was sent out to sea on the Coast Guard Cutter Tampa by WEEI of Boston, Massachusetts, and recorded instrumentally by Mr. Murray, at Newport, as well as being heard by many listeners.

Still other tests along similar lines were conducted by broadcasting stations in other parts of the country. Reports on some of these stations, as well as on the four stations co-operating with us, have been collected by other agencies, notably by Mr. Charles H. Van Housen, Radio Editor of the Philadelphia *Evening Public Ledger*. Finally, Mr. H. deA. Donisthorpe of the Marconi Company, New York City, kindly asked the operators of his company who happened to be on ships at sea near the path of totality, to observe any variation of radio signals from either side of the Atlantic.

That summarizes the data which we have to analyze. Complete study of it has not yet been possible. Some conclusions, however, begin to emerge.

Our own registered listeners may be divided into three groups, (1) those where the listener and the broadcasting station were on the same side of the shadow path; (2) those where listener and station were on opposite sides of the shadow path; (3) those where both the listener and the station were within the shadow path. By "shadow path" we mean, of course, the path followed by the spot of totality as it swept across the United States. Let us now consider what these groups of listeners heard.

There are many variations and contradictions. Some of these may be due to local disturbances or to accidental faults of the receivers. Some may have a deeper meaning which will be discoverable, doubtless, on further analysis. Ignoring these, for the present, and taking merely the rough average of the reported results we find:

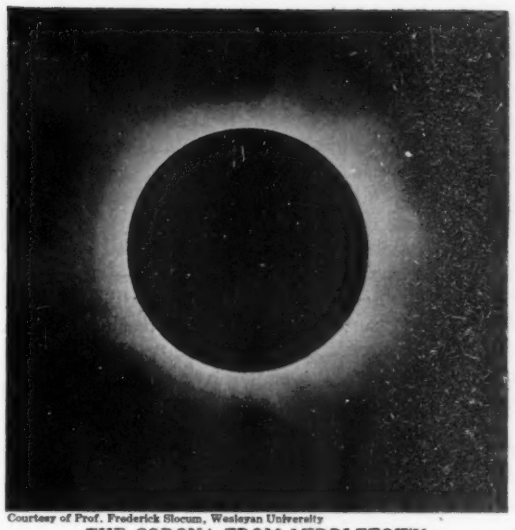
Results Differ With Position

1. When listener and transmitter were on the *same* side of the shadow there was a gradual *increase* in signal strength, beginning about twenty minutes before totality and falling off again by about ten minutes after totality.

2. When listener and transmitter were on *opposite* sides of the shadow there was a *decrease* in signal strength beginning a few minutes before totality and lasting until well after totality.

3. When both listener and transmitter were *within* the shadow there was a relatively sharp *increase* in signal strength practically coincident with totality at the transmitting station. This fell off rather quickly after totality was over.

When both the transmitter and the listener were very close to one side of the shadow path, although not actually within it, or when one was inside and one outside of the shadow, the results appear to approach, in general, to the type of group 2; that is, there was a *decrease* in signal strength as the shadow of the eclipse became nearly total.



Courtesy of Prof. Frederick Slocum, Wesleyan University

THE CORONA FROM MIDDLETOWN

The twenty-inch refracting telescope of Wesleyan University, Middletown, Connecticut, gave this photographic image of the corona

This effect is illustrated by the results at the Scientific American's observing station, at Easthampton, Long Island. This station was well within the shadow. Transmissions were observed at intervals from WBZ and WOR but the effect in question appears most definitely from the record on WGY. This station, it will be noticed, was just north of the shadow path, so that the waves from it to Easthampton passed mainly through the area affected by the total shadow.

Received signals from WGY were recorded at Easthampton automatically. A Grebe Synchrophase receiver was tuned in on WGY early in the morning and was connected to a phonographic recording apparatus consisting of two standard Ediphone dictating machines, one telephone of the radio headset being attached to the mouthpiece of each Ediphone. By starting the second Ediphone just before the recording needle of the first Ediphone reached the end of the record, we were able to provide for

Carpenter-Goldman Laboratories, Inc.

HOW THE RADIO PROGRAM WAS RECORDED

Mr. F. X. Walsh (left) and Mr. A. P. Lane are adjusting the Ediphone receivers used by the Scientific American observing party

"International News Reel"

THE RADIO RECEIVER AT EASTHAMPTON

The program from WGY was picked up by this radio receiver and fed into the recorders of the phonographs shown in the adjoining picture

changing records and to obtain a phonographic record of the entire transmission, from 8:40 to 9:40 A.M.

It had been expected that the effect of the eclipse between these two stations would be the usual effect of darkness, that is, an increase of the signal strength. That did not happen. What we did record on the Ediphones was a decrease of signal strength. At 8:58 A.M., eleven minutes ahead of totality at the longitude of WGY and fourteen minutes ahead of totality at Easthampton, the signals faded from normal daylight strength to an intensity so low as to be without effect on the Ediphones although very faint signals could still be heard in the headphones. At approximately 9:35 A.M., twenty minutes after totality was over, the signals came back slowly to approximately normal daylight strength.

A possible explanation for this behavior emerges from the instrumental results of Mr. Pickard, as reported in preliminary manner before the Institute of Radio Engineers on February 4, 1925, and somewhat more completely by subsequent private communications to ourselves.

Radio engineers have suspected for some time that the normal transmission of radio waves is over a dual path. One of these, called the "direct path" or the "ground-wave path," is along the surface of the ground or of the water. This corresponds to the older "gliding wave" theory of radio transmission, the theory that assumed all transmission to be by a wave attached more or less firmly to the earth's surface, just as the waves of "wired radio" are attached to the wire along which they travel.

One Path High in Air

The other path believed to be followed by a part of the radiation is the so-called "indirect path" or "upper-wave path." This part of the energy is supposed to travel through the upper part of the earth's atmosphere; bent around the earth, perhaps, by the right combination of electric properties in this part of the atmosphere.

It has been found by Mr. Pickard, not only in this experiment but in many earlier ones, that the signal strength of a distant station, particularly at night, shows a great many momentary fluctuations, representing a short-period "swinging" or "fading." These are believed to be due to transient alterations in the length of the transmission path along the "upper" or "indirect" route of the wave. These variations cause the indirect part of the wave alternately to reinforce and to oppose the direct part of the wave. Thus the audible or recordable variations are produced.

The eclipse occurred at an hour in the morning when these fluctuations were still prominent and in the instrumental records obtained, analysis shows that the indirect part of the wave was apparently affected more than was the direct part. The upper or indirect wave suffered so severely, it appears, as to be almost destroyed at some of the stations and for a part of the eclipse. The result was two-fold. First the momentary fluctuations of the signal strength—the short-period fading—were smoothed out. Second, the total signal strength, being now due solely to the direct or ground wave, became much weaker than when both parts of the wave were arriving together and contributing to the field strength at the receiver.

Darkness Affects Ionization

It is easy to see how the upper, indirect wave might be interfered with by the eclipse. Darkness alters the ionization of the air. This, in turn, alters the speed of the wave. The alteration is not likely to be uniform. Accordingly the progress of the wave will be disturbed in a most complicated manner, with ample opportunity for such deviation of this wave, either upward or downward, as to greatly decrease its strength at the distant receiver.

In the case of a transmitting station inside the shadow path, as, for example, WGR, at Buffalo, there is another effect that enters. The indirect or upper part of the departing wave, in order to reach the upper atmospheric layer where the conductivity is higher and where the distant transmission is to occur, is compelled to traverse the layer of lower atmosphere lying immediately above the station, between the antenna and the upper, conducting layer. The absorption of wave energy in this lower part of the atmosphere is believed to be relatively high. It is probably higher when the air is illuminated by sunlight than when it is dark. Accordingly, it is probable that one effect of the eclipse was to decrease this absorption, thus allowing more of the wave energy to reach the upper, conducting layer, and strengthening the indirect part of the wave. It is possible that this explains the increased signal strength reported for cases in which both the transmitter and the receiver were within the total portion of the shadow of the moon.

Evidence from the portable station at Escanaba, Michigan, offers some confirmation. This station, too, was within the path of the shadow. According to a report of results kindly supplied by Dr. R. H. G. Mathews, Chief Engineer of the Zenith Radio Corporation, listeners at a distance from Escanaba reported an increased range for that station during the eclipse period.

The frequent increase of signal strength reported when both transmitter and receiver were well outside the limits of the shadow is probably explainable merely as a partial night effect. Although the path of total shadow was limited, the rest of the United States experienced a partial eclipse. Over much of the country the approach to totality was more than ninety percent. This corresponds to a considerable decrease in the intensity of sunlight. In effect, it was a partial night. Radio transmission is well known to be better at night than during the day. Although this may not be the whole truth about the effect of the partial phases of the eclipse on radio it is probably a part of the truth.

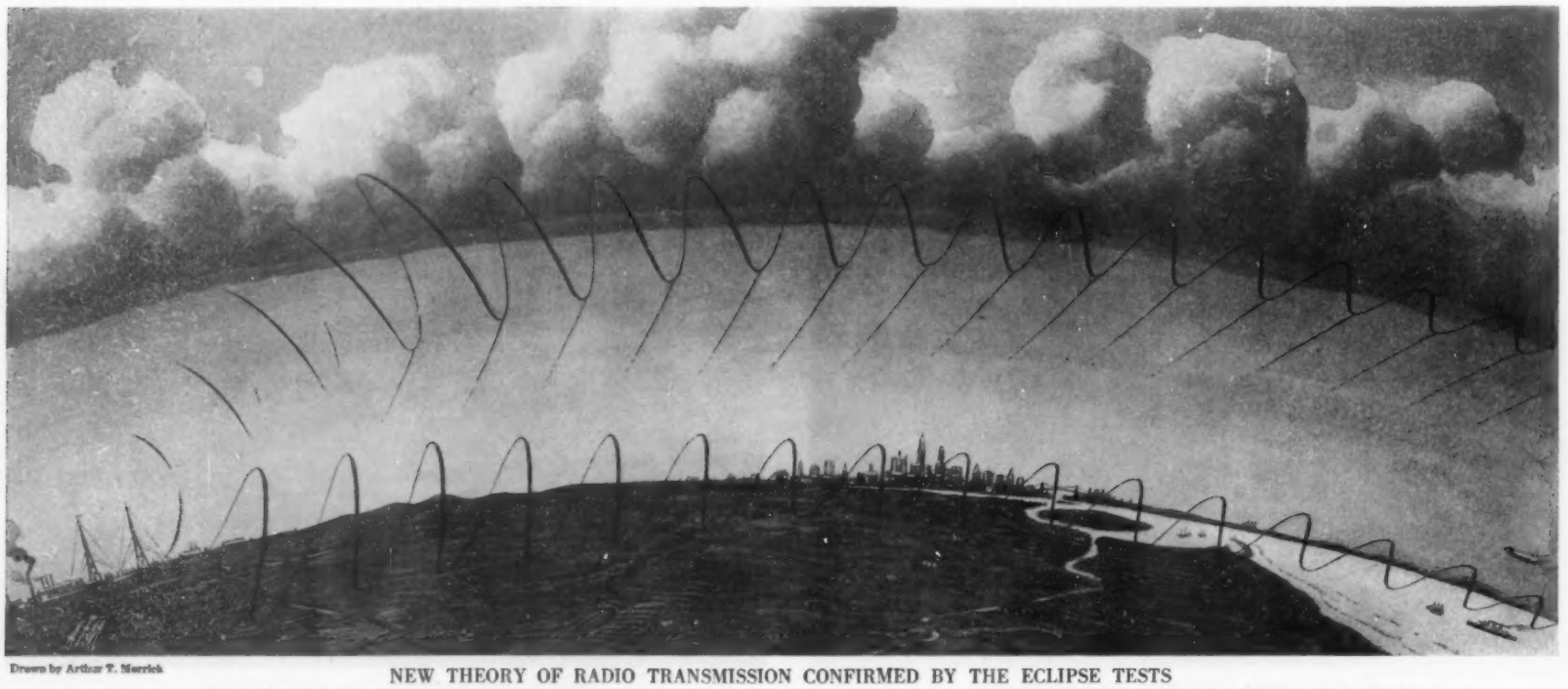
Further Results to Come

These interpretations must not be taken, of course, as more than tentative suggestions made in advance of full study of the data. The idea that comes nearest being established is, in our opinion, that of the dual path of the waves and of the effect of the eclipse in decreasing the upper or indirect part of the wave. Credit for this idea must go to Mr. Pickard, not to us.

It is expected that further study of Mr. Pickard's instrumental results as well as of our own listeners' reports will define this idea much more exactly than is possible at present. As results become evident or are announced by others they will be noted in the Scientific American.

Our readers may be assured that we will give them, as promptly as possible, full accounts of any additional radio conclusions which emerge from the study of the eclipse records.

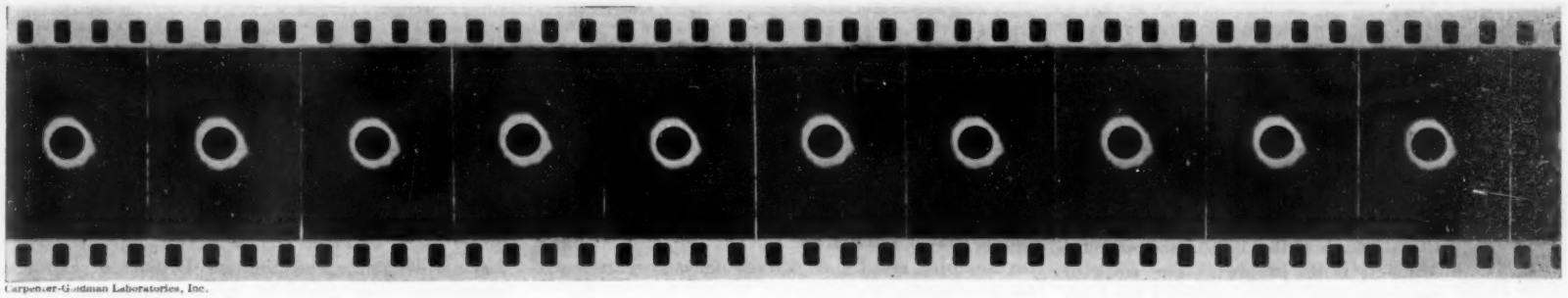
The radio investigation was a most successful piece of co-operative effort. We want to extend our very best thanks to all those who helped in it. We shall let you know everything that happens as a result of it and of its scientific aftermaths.



Drawn by Arthur T. Merrick

NEW THEORY OF RADIO TRANSMISSION CONFIRMED BY THE ECLIPSE TESTS

The radio wave goes out from a transmitting station over two paths; one along the ground surface, the other through the upper part of the atmosphere. The shadow of the eclipse affected these two wave-paths unequally



Carpenter-Goldman Laboratories, Inc.

Prize for Criticism of Eclipse Motion Picture

An Announcement of a Contest Which We Hope All Our Readers Will Join

DURING the eclipse the Scientific American party, at Easthampton, Long Island, made a complete motion picture record of the sun. A strip of this film, showing the corona during totality, is reproduced above.

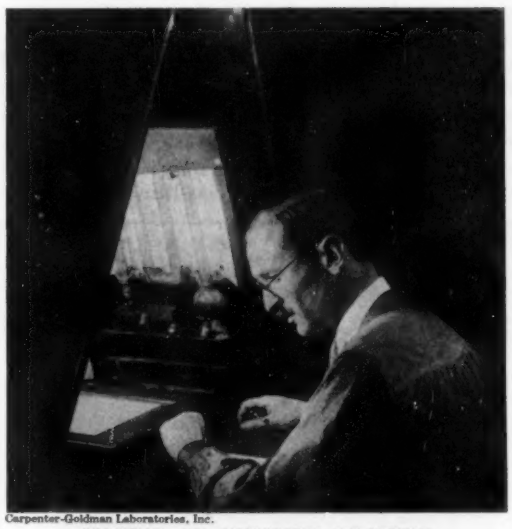
This record was made, originally, for scientific purposes only. But since the eclipse we have had so many requests for this film that we have decided to prepare a special motion picture dealing with the entire event. This picture is now in preparation under the direction of the well-known motion picture experts, Mr. Arthur Carpenter and Mr. F. L. Goldman. It will probably be ready for release in the theatres even before this issue is on sale.

Profits to Go to Astronomy

The picture is not a commercial enterprise. In return for much assistance from the scientific professions, we have agreed that any profits earned by the picture shall go to the American Astronomical Society for scientific purposes.

The film will show, not only the eclipse itself, but all the scientific investigations which were carried out. There will be views of astronomers operating the instruments in the great observatories; of the scientists aboard the airship Los Angeles; of the multitudinous preparations made long before the eclipse; of the radio investigations and of the results obtained from them.

Special models of the earth and moon have been built in order to show just how an eclipse occurs.



Carpenter-Goldman Laboratories, Inc.

MAKING AN ANIMATED DRAWING

Mr. Goldman is photographing one of the series of animated diagrams showing how the eclipse affected the reception of radio programs

Every available bit of scientific information has been collected for this unusual effort to show a scientific event correctly and interestingly on the silver screen. Some of America's most distinguished scientists are giving us full and gratuitous cooperation.

There is something *you* can do. The problem of presenting scientific fact by motion pictures is a pressing one. Properly used, the movies may be a great means of popular education. We are anxious to discover how this can be done. Is the eclipse film a step in the right direction or is it not?

Accordingly, if you have seen this film, sit down and write us a letter about it. Tell us what parts of it you thought good; what parts you thought bad. Tell us, too, whether you think we are on the right track toward the use of films in scientific education. What subject, if any, ought we to attempt next? It is not necessary to see the film. We will send you on request an illustrated synopsis of it. You can write your criticisms from this.

One Hundred Dollar Prize

Just to make it a little more interesting for you we are offering a prize. For the most helpful letter of criticism, written along the above lines and mailed to us before July 1, 1925, we will give a prize of one hundred dollars in cash. There are no conditions except that helpful suggestions will be rated higher than mere objections. Our Editors will be the judges. We cannot agree to enter into correspondence about this contest. If you want the receipt of your letter to be acknowledged, enclose a reply postcard. Address: Movie Contest Editor, the Scientific American, Woolworth Building, New York, N. Y.

Even if you do not care about the hundred-dollar prize, send us your letter of criticism anyway. We want to know what to do. You can help us to decide.

Carpenter-Goldman Laboratories, Inc.

HOW THE MOTION PICTURE RECORD WAS MADE

This photograph, taken at Easthampton during the eclipse, shows the making of the actual motion picture. This camera was operated continuously for over two hours in order to show all phases of the eclipse

Carpenter-Goldman Laboratories, Inc.

SHOWING THE MOTION OF THE EARTH AND MOON

A model of the earth and a small ball to represent the moon have been used to produce a remarkable motion picture scene showing the relative motions of these bodies and the exact way in which eclipses happen

Our Point of View

Battleship Annihilators

IN the long list of battleship annihilators, the airplane is the latest, and General Mitchell is its prophet. The work of annihilation has been going on for forty years. Periodically, enthusiastic and highly imaginative prototypes of the gallant general have sounded the knell of that huge, slow-moving, costly contraption, the battleship. Always the mastodon was to be killed by the midget. Always, the midgets were to be "built in swarms"; in swarms they were to "swoop down" upon the bewildered Behemoth; and, as he sank beneath the waves, a new era of naval warfare was to be ushered in.

Yet, strange to say, when the chosen experts of the three leading navies of the world gathered in Washington to arrange a mutual rating of naval strength, they selected, not the torpedo boat, nor the destroyer, nor the submarine, nor the fast scout, nor the swift battle cruiser, nor even the airplane, as the basis of strength. They selected the battleship!

And they made this choice because, although each of these several craft had, in its turn, been heralded as sounding its death knell, the battleship still held its supreme position as the backbone of the navy and the final arbiter of battles; while the "annihilators" had fallen, automatically, into their respective, subordinate positions, as important auxiliaries to the fighting battle line.

The present hullabaloo over the airship-battleship question is strongly suggestive of earlier enthusiasms over cheap "kill-alls" in naval warfare. There was the torpedo boat—small, swift, hard to see, hard to hit, rushing out of the night or the fog, and delivering its deadly torpedo! The answer was found in the torpedo boat destroyer, larger, swifter, heavily armed, and able to keep the sea.

Then the destroyer itself was to succeed where the torpedo boat failed; but an effective answer was found in the rapid-fire, five and six-inch anti-torpedo battery, each gun capable of delivering from six to ten armed shots per minute at the on-rushing craft.

Next among the annihilators was the submarine; but in the destroyer with its listening devices and its depth bombs was found the annihilator of the annihilator; and in the late war the Grand Fleet did not hesitate to sweep the North Sea, though at times its course was beset with the undersea craft.

And now we have with us the airplane; and, scorning the lessons of the past, its over-zealous advocates are singing the same old swan song and telling the bewildered public and its scarcely less bewildered Congress to consign our battleship fleet to the junk heap; and this for the reason that, at last, it is confronted with a real, honest-to-goodness, annihilator.

Well; we think not.

It was our privilege to witness the bombing of the German ships off the Virginia Capes. We saw a small, frail cruiser subjected to an all-day attack by machines flying at a low altitude at which they would never dare to fly in actual warfare. The ship was anchored; she had neither man nor gun aboard. Yet it was late in the afternoon before she slowly went under. The battleship, also anchored and without defense, was bombarded all one afternoon. Next day she was still afloat and but little below her loadline, and it took some hours of further bombing to put her down. We were not impressed.

It is true that planes, bomb-sights and bombs have been greatly improved since then. But so has the anti-aircraft defense of ships. The airplane is a most valuable auxiliary in the makeup of a well-found navy. For patrol, for spotting, for scouting, for bombing and for engaging enemy aircraft it will be invaluable.

But it has not "sounded the death knell" of the battleship.

Lowering the Great Lakes Level

THE cities which border on our Great Lakes are greatly exercised, and very properly so, over the lowering of the levels of these inland seas. With the growth in the size and draft of ships, the question of sufficient depth in canals and harbors has become very acute and the matter of merely a few inches in the available depths is of extreme importance. In addition to the natural discharge by way of Niagara River, there have been created various artificial discharges, the most important of which is that through the Chicago River into the Plains-Illinois River, and thence into the Mississippi. Formerly the sewage of Chicago flowed into the Chicago River and emptied into Lake Michigan, from which Chicago draws its water supply. In order to divert this sewage from the lake, the flow of the Chicago River was reversed, and by means of widening, dredging and a connecting canal, known as the Main Drainage Canal, the sewage was diverted into the Mississippi.

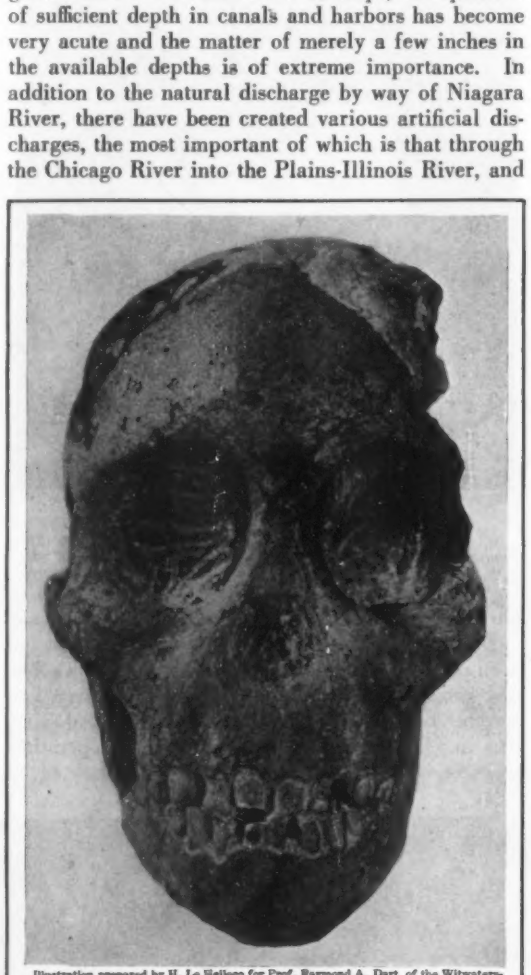


Illustration prepared by H. Le Heliocc for Prof. Raymond A. Dart of the Witwatersrand University. Reproduced by courtesy of "Nature" through "The Illustrated London News"

A NEW LINK IN MAN'S ANCESTRY

Just discovered at Taungs, South Africa, by Professor Raymond A. Dart, this remarkable fossil skull appears to represent a creature intermediate between man and the apes, but with a brain of distinctly human type. Few discoveries in human evolution have aroused so much interest. There will be a full account of this astonishing "missing link" in our next issue

The Main Drainage Canal was built with a capacity to carry 10,000 cubic feet per second, which was sufficient to dilute the sewage sufficiently to serve a population of 3,000,000. The War Department claims that it has allowed a diversion of 4,167 cubic feet per second only; but at the present time about 9,000 cubic feet per second is being diverted from Lake Michigan. The Sanitary District of Chicago, therefore, finds itself in direct opposition to the War Department. The Main Drainage Canal was opened in 1900; but so rapid was the rate of growth of population and of the industries of Chicago that in 1908 steps were taken to supplement the disposal through the canal, with independent works for dilution of a portion of the sewage by sewage treatment. The Sanitary District of Chicago is confronted with a very serious problem, which would be enormously aggravated should the city be obliged to cut the flow down from 9,000 to the War Department limit of 4,167 cubic feet per second.

A plan must be found which will be fair both to the city of Chicago and to the various cities bordering on the lakes, whose harbor depth must be maintained and if possible increased.

Such a plan can be found in providing regulating works at the various outlets from the lake, particularly at the head of the Niagara River. These works are of a simple character and they would render it possible to raise the lake level and maintain it at a least minimum depth, even though Chicago should draw from the lakes its desired 10,000 cubic feet per second. The Sanitary District of Chicago, the various cities affected, and the War Department should get together and formulate a plan which will permanently meet all the necessities of the case.

What Is Wrong With the Barge Canal?

WHEN a single state has spent some $200,000,000 on a public enterprise it has a right, surely, to demand that it get back something for the outlay. The State Barge Canal, it is officially announced, has cost the above sum of money; it has been in operation for several years; but it is carrying today less freight than the old Erie Canal was wont to carry in its palmy days. During the six years of its operation the Barge Canal has carried 9,842,884 tons of cargo; but the old Erie Canal, of which the Barge Canal is an enlargement and improvement, actually carried during the period from 1887 to 1893, 32,593,646 tons of cargo. In view of these facts Governor Smith has suggested that a committee be appointed to investigate its usefulness to the state. The main causes of its apparent failure are, first, that there have not been available sufficient funds to maintain it at its full depth of twelve feet (in some places the depth has shoaled up to eight or nine feet), and, secondly, the people who dwell along the route of the canal have failed to take advantage of the cheaper transportation which it offers.

The remedy for the first obstacle is to be found in properly financed operation; the second difficulty can be met only by getting the shippers into a condition of canal-mindedness. The long stretch of years occupied by the construction of the canal obliged shippers to use the railroads, and the habit thus formed seems hard to overcome. Properly maintained and fully equipped with up-to-date power-driven barges, and operated upon strict modern business lines, the Barge Canal will take its place as a most valuable means of transportation for through trade from the Great Lakes and for a large share of the local freight of the industries and general trade of the Mohawk Valley. But, above all, the canal must be freed from the devastating influence of party politics.

J. B. W.

The Psychic Investigation

Claims of "Margery" to Produce Supernormal Phenomena Are Rejected by the Committee

THE famous Margery case is over so far as the Scientific American Psychic Investigation is concerned. On February 12, 1925, two members of the Psychic Committee released for publication formal statements announcing that they had been unable to obtain convincing evidence of the supernormal production of physical phenomena. Together with the statements issued previously by other committee members, this constitutes a four-to-one vote against the claims of the medium.

"Margery" is not a professional medium. She is, in fact, Mrs. Le Roi G. Crandon, the wife of a well-known surgeon of Boston. In the issue for November, 1924, we published statements from four members of the committee, dealing with her case. After the issuance of these statements, Dr. Prince and Dr. McDougall continued the investigation of the case. The other three members of the committee have had no further sittings.

Joint Statement by Dr. Prince and Dr. McDougall

FEBRUARY 9, 1925.

We, the undersigned members of the committee for psychic investigation appointed by the Scientific American, report as follows on the "Margery" case.

We have shared in the labors of the committee which has devoted a large amount of time and careful observation to this case, affording every facility for the production of phenomena. We have observed phenomena, the method of production of which we cannot in every case claim to have discovered. But we have observed no phenomena of which we can assert that they could not have been produced by normal means, although we have looked for such phenomena patiently and with open minds. It is obvious that we cannot prove that the "medium" never has produced and never can nor will produce supernormal phenomena. But in our opinion we have afforded the "medium" ample opportunities for the demonstration to us of such phenomena and no such demonstration has hitherto been made.

Therefore, we report that, in our judgment, the "medium" is not entitled to the award of the prize offered by the Scientific American for the production of supernormal physical phenomena.

WALTER FRANKLIN PRINCE (Chairman),
WM. McDOUGALL.

Supplementary Statement by Dr. Prince

FEBRUARY 9, 1925.

In November last I guardedly stated that "thus far the experiments have not scientifically and conclusively proved the exercise of supernormal powers" by "Margery."

Since then I have had three sittings: two of these were unworthy of consideration, since, what with the complete darkness and the medium's husband close to her on one side, no proof of genuineness in the phenomena produced was possible. The third was under conditions which I considered satisfactory for the time being, since I had secure control of the medium's hands and feet in near-daylight, with the bell-box on my knees a few inches from those of the medium. Twice when my attention was momentarily abstracted the sound of a bell came from the region of the bell-box, but ceased instantly as I looked down, with no movement of the contact board perceptible. Since the medium volubly promised me repeated experiments under precisely similar circumstances I expected in one or two further sittings to be able to determine whether the sound of a bell actually issued from the bell in the box or from another such as could easily have been concealed between the medium's knees and under her garments.

But all such opportunities have since been denied me, in spite of my repeated efforts to obtain them, nor have I been able to secure any prospect that sittings in a red light would be allowed me. For some weeks Dr. Crandon has refused to allow my presence under any circumstances. The work of the committee having been brought to an end through his own act, the time has come for my final official statement.

No sitting at which I was present was to me convincing, and I am still profoundly unconvinced, after giving respectful attention to all that advocates have had to say. In fact I could write a chapter of indications which, in the absence of contravening proof, seem to tell the story of normal and deceptive production.

Although fully aware of the scorn which the committee would incur by its policy of utmost leniency toward the conditions said by the medium and her husband to be necessary, I fully concurred in that policy. So long as the alleged conditions on which phenomena depend are violated, the claims of the phenomena cannot logically be refuted. We gave the medium a long series of opportunities to establish her claims under the conditions alleged to be necessary, embarrassing and suspicious though they were. In my judgment she has not made out a case.

Walter Franklin Prince

Psychic Investigation to Continue

The Scientific American's offer of the Psychic Awards expired on December 31, 1924. That was the date set when the awards were offered in the issue for January, 1923.

It was stipulated, however, that any applications on hand and not acted on at the date of expiration would be investigated later. The Psychic Committee will be continued in existence as long as may be necessary for this purpose.

A number of such applications are on hand. All will be investigated, as rapidly as possible, by the Psychic Committee. Accounts of the committee's further investigations will be printed from time to time in the Scientific American.

Supplementary Statement by Dr. McDougall

FEBRUARY 8, 1925.

I think the time has come when, as a member of the committee for psychic investigation appointed by the Scientific American, I should express my opinion on the "Margery" case. I should have preferred to have a few more sittings with this case, before expressing my opinion, but the unfortunate degree of publicity already given to the case forces my hand.

As long ago as November, 1923, when I had enjoyed only a few sittings, I wrote to "Margery's" husband, stating frankly that I was inclined to regard all the phenomena I had observed as produced by normal means, possibly with the admirable design of testing and exposing the gullibility of scientific men who venture to dabble in the field of "Psychic Research." Since that date I have taken part in three series of sittings, eagerly looking for evidence of supernormal phenomena and doing my best to keep my mind open to such evidence. During this period, the inclination described above has grown steadily stronger in the main, in spite of some minor fluctuations, and now has become well-nigh irresistible. I feel sure that, if it were worth while to set down in detail the many observations and inferences which have contributed to bring me to this state of mind, all sensible and unbiased persons who could accept my statements as those of a trustworthy reporter would be inclined to the same conclusion.

Wm. McDougall

Statement by Mr. Orson D. Munn

FEBRUARY 11, 1925.

The statements of the members of our Psychic Committee, herewith made public, speak for themselves. Comment from the staff of the Scientific American is not really required.

Nevertheless, I may add, for what it may be worth, that we concur entirely in the opinions expressed by Dr. Prince and Dr. McDougall. Speaking for myself, I am of the conviction that no evidence of supernormal phenomena has been produced and that many circumstances of the case create a strong suspicion that all of the reported phenomena have been brought about in quite normal and understandable ways.

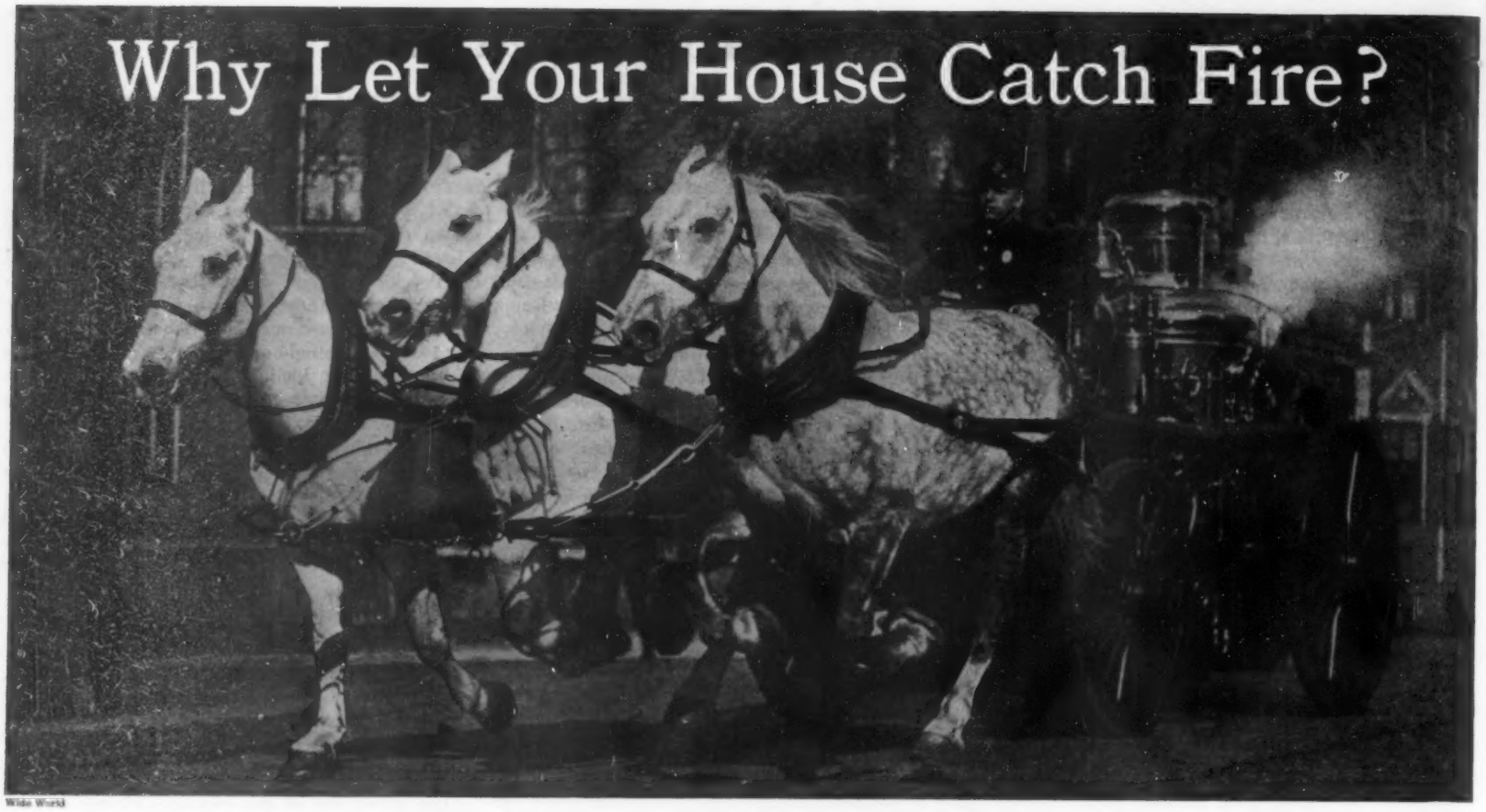
The committee has been exceptionally patient. As is apparent from their statements, some of them had reached a tentative unfavorable opinion months ago. In the meantime the case has been tried and retried, most vociferously, in the newspapers and elsewhere. Nevertheless, the majority of the committee kept quiet and remained at work. In the most admirable scientific spirit they declined to be moved by the clamor of either side but continued sittings in a whole-hearted effort to ascertain the truth. It now seems useless to delay the decision longer.

Last November, two members of the committee filed statements declining to recommend the granting of the award to "Margery." Together with the two statements now announced, these constitute a vote of four out of five. The psychic award will not be granted to "Margery." It is only fair to state, however, that this fact has no financial significance. At the beginning of the sittings with her, "Margery" stated that she was not applying for the money award and would not accept it personally, if received.

The Margery case being disposed of so far as the committee and the Scientific American are concerned, the committee will now proceed with the investigation of other persons who have applied for the award and whose cases are awaiting attention. There has been no change whatsoever in the personnel of the committee nor in its plan of procedure.

Orson D. Munn

Publisher, The Scientific American.



Wide World

A Famous Fire Chief Gives Some Authoritative Advice on How to Help Decrease America's Staggering Bill for Fire Losses

By John Kenlon

Chief of Fire Department, New York City

CAN you picture to yourself a city the size of Providence, Rhode Island, with every one of its homes completely on fire from cellar to garret and no hope of suppressing the flames until the dwellings are reduced to blackened ruins?

If you can, you will visualize the fire losses of the United States last year, for they represented the destruction of about half a billion dollars' worth of property, or an amount sufficient to build fifty thousand, ten-thousand-dollar dwellings. These would supply homes for approximately two hundred and fifty thousand people, assuming that there are still five members to the average American family.

And to this tremendous destruction of material assets should be added the loss of human wealth represented by the 15,000 fatalities that occur because of fire. Further than this, there are some 17,000 persons painfully injured.

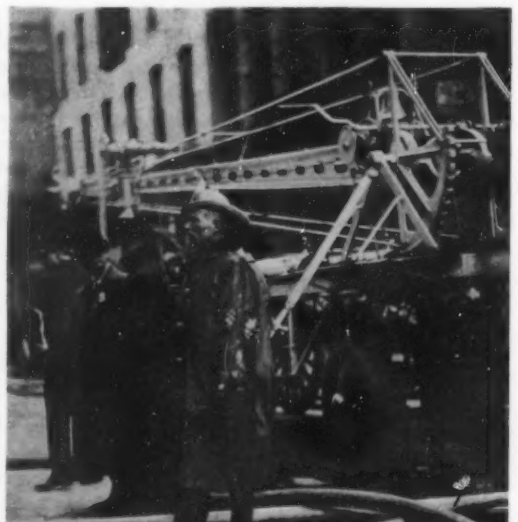
All of this is waste. The nation is made poorer by every fire that takes place, whether the structure or materials involved are insured or uninsured.

The effect would have been similar if last year 100,000,000 of the residents of the United States had formed a huge line and upon reaching a given point had each thrown a five-dollar gold-piece into a bottomless pit. The $500,000,000 would obviously be lost forever and would do no one any good. So it is with fire destruction, although we must recognize as an exception to this statement the "firebug" who makes a business of "burning to defraud" and eludes conviction for a time. Whenever he profits, however, it is at the expense of honest citizens and of the community at large.

All of this is direct property destruction, yet the huge total does not tell the full story of the cost of fire. To the five hundred million dollars must be added the expense for fire department maintenance and that portion of civic water supplies made necessary for precaution against fire.

No exact figures are possible but it is believed that this part of the fire bill is about equal to the values consumed. On this basis we are paying the Fire Demon something like a billion dollars a year!

Fire strikes at the basis of our prosperity in several ways. It destroys not merely materials, but materials plus human labor, and often life as well. The burning of a wooden house, for example, does not mean simply the burning of the trees which furnished the lumber. It means the burning of the transportation which took the logs to the mill, of the sawing that converted them into lumber, of the handling that brought the lumber to the place of erection and of the planing, trimming and finishing that made the lumber into a house, as well as of the furnishings which the house contained. In short, it means the burning of the work of all the minds and hands that caused the complete structure to be built.



A. Dreyfous

CHIEF KENLON IN ACTION

He has been a member of the New York City Fire Department for 37 years and its chief for 13 years

Take another instance. An immense grain elevator burns. Several hundred thousand bushels of wheat or corn are destroyed. Somewhere in the world people are starving for lack of the nourishment which this grain would give. Here again much more than grain and buildings are destroyed, for back of the grain are the thousands of acres upon which it was grown, the months of labor required for planting, cultivating, harvesting, threshing and transporting, as well as the complicated processes of marketing, financing and storing. All of these are nullified by fire.

A large factory burns and the loss is even greater. An extensive business, furnishing support for hundreds of families, is weakened and perhaps destroyed. Its workmen become idle. Many drift away to other employment. Its trade is lost.

Whenever you hear the fire engine bell, and its clang reaches your ears all too often, you may consider it as the symbol of a gigantic civic cash register, although in this case the money is continually going out instead of coming in. It might be called America's "burning shame."

Mr. A. Dreyfous

FIGHTING BOTH FIRE AND ICE

At the famous Equitable Building fire the cold was so intense that spray from the fire streams froze instantly

America continues to pile up its stupendous ash-heap because of ignorance, heedlessness and greed. My own experience amply confirms the contention that the Fire Demon is sure to pay you a visit, sooner or later, unless you forestall him.

Fires start because of the careless handling of a number of hazards which will be discussed. They spread through structures with such rapidity because of the general lack of protection to stairways and other vertical openings, such as elevator shafts, chutes of various kinds and dumbwaiter shafts. Go into the cellar of almost any apartment house and see if you do not find the door of the dumbwaiter shaft wide open, ready to act as a flue for any blaze that may originate in the basement, usually the most dangerous portion of the entire structure. You may also find the metal-clad door at the foot of the cellar stairs propped open.

If I could have my way I'd make every apartment house owner install sprinkler lines in the cellar and lower stairway of his property—then we would see considerably smaller loss of life in dwelling fires.

Matches Are Never Safe

The preventability of most of our fire loss is obvious when we consider the hazards responsible for the largest totals of destruction today. The leader, for example, is known as "Matches and Smoking." This single cause is piling up property losses running to approximately $26,000,000 a year. It is a sort of twin because most of the matches that start fires are those discarded by careless smokers. Unfortunately, there are also thousands of fatalities caused each year by matches used as playthings by children. The danger of allowing little boys and girls to obtain these small fire sticks seems obvious enough, yet parents continue to leave matches around within reach of the youngsters, with unfortunate results. *No* match is safe.

The fire that destroyed the Equitable Life Assurance Society Building at 120 Broadway, New York, the worst blaze I ever had to fight, started from a lighted match carelessly thrown into a waste paper basket in the basement. Wooden trim and open elevator and dumbwaiter shafts furnished ideal paths for the flames which flared upward and mushroomed into the upper floors. Six lives were lost and the property damage amounted to about $2,000,000.

Another striking incident of this kind occurred in an eastern warehouse fire a few years ago. Chlorate of potash was stored in the place and one of the workmen handling the chemical threw a lighted cigarette stub on the floor, grinding it under his heel. There was a great deal of the chemical about, in powdered form, and a terrific explosion ensued with a subsequent loss aggregating $2,000,000. This small roll of tobacco and paper has been referred to as "The $2,000,000 Cigarette!"

"Defective Chimneys and Flues" are also responsible for heavy fire damage. The annual toll runs in the neighborhood of $18,000,000, according to the records of The National Board of Fire Underwriters. This hazard is structural and indicates the careless methods that are followed by thousands of architects and builders. It may be stated briefly that the way to avoid fires from this cause is to build chimneys solidly from the ground up and never upon brackets or beams; to build them with the bricks flat, instead of upon edge, and to have them lined properly with fire clay.

Cleaning flues at least once a year if hard coal is employed for fuel, and twice a year if either wood or bituminous coal is used, is a necessary precaution to prevent soot blazes and to preserve the draft. A brick wrapped in carpet and lowered into the chimney from the roof by means of a long rope will usually answer for cleaning purposes. Soot accumulations may be kept at a minimum by occasionally throwing a pound of table salt on the fire when it is red hot. The damper should then be kept open for half an hour or so in order that the gas created may find its way harmlessly to the outer air.

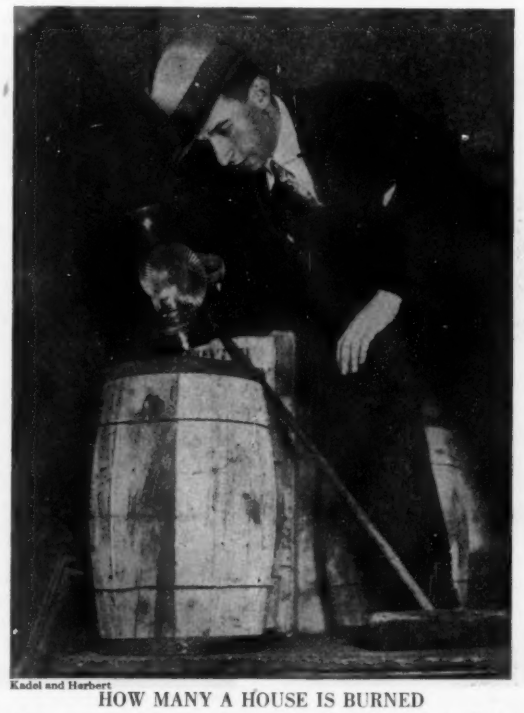
When a chimney fire occurs it may be extinguished by throwing a few pounds of salt, earth, sand or ashes into the flue opening at the top.

Beware of Ill-placed Stoves

Stoves, furnaces and smokepipes, which are classed together by the actuaries, also occupy a prominent place on the list of major fire causes with yearly damage of about $16,000,000.

Many stoves are placed too near wooden partitions or too close to ceilings and walls constructed of wood lath and plaster; furnaces are set up with insufficient clearance between the top of the apparatus and the ceiling. The result is that fires frequently occur at such points. Combustible construction near heating appliances should always be protected by a covering of metal lath and plaster, by sheet metal and asbestos, or by metal sheathing having an air space behind.

Kitchen ranges not resting on legs should have foundations of brick or cement at least three inches thick and should be about eighteen inches from any woodwork, unless the latter is protected by asbestos



Kadel and Herbert

HOW MANY A HOUSE IS BURNED

The combination of oil lamps and cluttered stair landings may mean a fall and a dangerous fire

Brown Bros.

A NEW PLACE FOR ICICLES

The fire fighter has neither time nor thought for himself, even to comb the ice out of his whiskers

or metal sheathing having an air space behind it, or by both materials. In such case, a six-inch clearance is considered sufficient. Even the floor beneath stoves supported by legs should be protected by sheet metal having a layer of asbestos sheeting beneath it and extending about one and one-half feet in front of the ash-door in order to render harmless any coals that may drop out.

The smoke-pipe furnishes the connection between the stove or furnace and the flue opening in the chimney. It ought to be taken down and cleaned at least once a year and replaced when it becomes rusted. Such pipes should always enter the chimney horizontally and be securely sealed with mortar where they fit into the flue aperture. They should never pass through floors or wooden partitions, but where such practice is absolutely necessary there should be ventilated metal thimbles in the walls or partitions surrounding the pipes.

Spontaneous Combustion a Danger

There is another important fire cause—spontaneous combustion—which is looked upon by a good many laymen as being a chemical phenomenon resulting only from laboratory experiments. According to the carefully analyzed reports of the National Board, however, losses to property from this cause approximate $15,000,000 a year. This form of ignition develops, for example, in waste materials where oily matter is present as well as in stored grains and in piles of bituminous coal. Furniture factories and other places where varnishing and painting is done have often been destroyed by fires from this cause. The presence of rags saturated with linseed oil is the chief reason. Soya bean oil and cottonseed pressings also cause spontaneous fires. Mineral oils are guiltless in this respect.

During recent years, the fire destruction charged against "Electricity" has shown what appears to be a definite decline, although the total still aggregates about $12,000,000 annually. Electricity is the safest form of light, heat and power when properly employed, but, due to faulty installations and the doctoring of fuses, it constitutes one of America's major fire hazards. The fuse, it should be noted, acts as the safety valve of the electrical circuit and when it "blows out" indicates an overload that should be removed. Plugging fuses with pennies, or other non-fusible metals, corresponds to the tying down of the safety valve on a steam boiler.

The sixth of the most serious causes of fire loss is known as "Sparks on Roofs." It shows a total of about $11,900,000 a year. The size of this item is due to the prevalence of wooden shingle roofs in all parts of the United States. While the use of

metal and composition shingles is greatly on the increase, there are hundreds of thousands of dwellings and small-town business structures with combustible roof coverings. As wooden shingles grow old they dry out and become fairly tinder-like so that even a spark from a chimney may be sufficient to cause ignition. In view of the part the wooden shingle roof has played in many city-wide conflagrations, or sweeping fires, the seriousness of this hazard has become widely recognized during recent years. As a consequence, something like one hundred and twenty cities have passed ordinances prohibiting the use of wooden shingle roofs on new buildings, and calling for the removal of old wooden roof coverings.

Fires from "Lightning" were once looked upon as a visitation from the heavens that could not be avoided, but experience has shown that properly installed lightning rods afford almost complete protection from damage by the elements. Nevertheless, it continues to be responsible for something like $11,500,000 in property destruction each year.

Gasoline, kerosene and other petroleum products are responsible for annual losses aggregating about $10,000,000. This is due in part to the astonishing ubiquity of the motor car. Sometimes the trusting operator lights a match to see whether his fuel supply needs replenishing and soon learns several things. Then there is the careless individual who performs the filling operation by the light of a kerosene lantern. Static electricity generated by the flow of the fuel through the filling hose is also responsible for many gasoline fires. Here is a danger that can be readily avoided, however, by making sure that the metal hose nozzle is in contact with the neck of the tank. As an additional precaution, the car frame may be grounded with a chain. In some cities grounding is required on the part of gasoline tank wagons.

Mother Burned by Gasoline

Gasoline is highly dangerous for home cleaning purposes and yet it continues to be employed by people who do not realize the explosive nature of gasoline vapor when it is properly mixed with air. Not long ago, in New York City, a young mother living in an apartment house started to clean a pair of gloves in her kitchen, using a pan filled with gasoline. Her small baby was in his crib in a nearby room and she closed the kitchen door so that the fumes would not affect him. She forgot all about the pilot light on the gas stove, however, and in a few minutes a flash-back from the stove to the pan occurred. It ignited her clothing and burned her so severely that she died soon afterwards.

A. Dreyfous

THIS HASP COST TWELVE LIVES

The door was closed and fastened with the hasp. Escape was blocked and twelve persons were burned to death

There is a touch of grim humor to the aftermath of this accident. The apartment in which it occurred is a large one and the next day it required two wagons to cart away the bottles of gasoline that were thrown out by the tenants.

Kerosene, being less volatile than gasoline is not as dangerous as the latter, but it is sufficiently hazardous to merit being handled with respect. There are still too many people risking their lives by pouring coal oil on sluggish kitchen fires and by using unsteady oil lamps. Oil lamps should never be filled while lighted and should never be carried about, particularly up and downstairs.

So much for the chief causes of fire. I think I have made it clear that a large part of our loss by burning is preventable and that it results from carelessness and ignorance. Both heedlessness and lack of knowledge concerning a given dereliction may be cured or modified by two things; legal action and education. In the continental countries of Europe, the Code Napoléon, which makes those who cause fire by their negligence personally liable, is rigidly enforced. This has a salutary effect upon the fire record. Probably the American temperament is so constituted that legal action along exactly the same lines would not be feasible in this country, although it is an interesting fact that our foreign element is responsible for the majority of our fires.

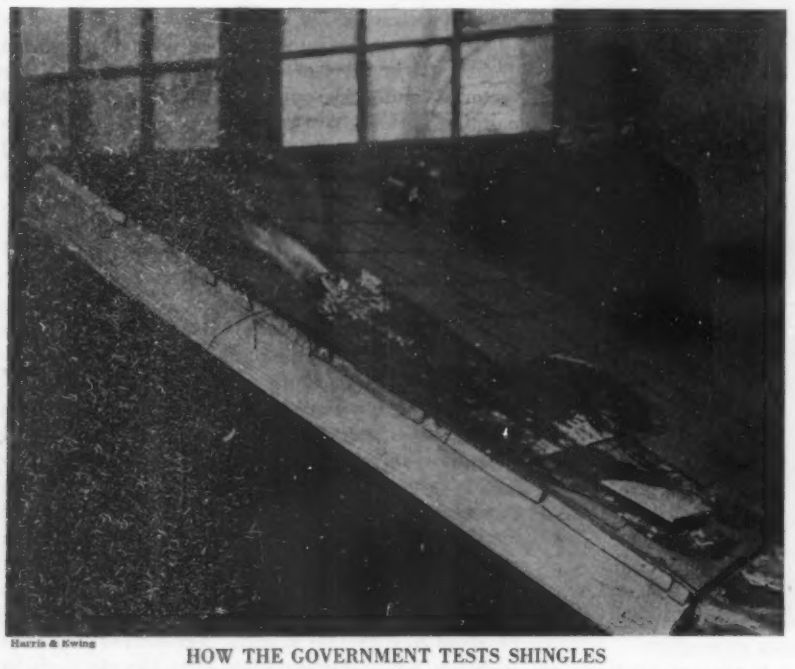
It does seem, however, that a great deal might be accomplished if the persons who, by their negligence, cause the destruction of property by burning were brought to book. It is true that in several of our cities and in the state of Pennsylvania acts of this nature have been placed in the statutes, but their strict enforcement is another matter.

Help Reduce Our National Ash Heap

In the field of legislation having to do with structural defects, on the other hand, there can be no question as to the ultimate benefits of the general adoption of standard building codes which call for the elimination of hazardous physical conditions. Perhaps legislation will have to be invoked before we are able to bring about a decided reduction in the size of our national ash-heap, although it would be impossible to over-emphasize the value of education concerning fire dangers.

In this great effort of education the fire chiefs of the country, I am proud to say, are taking a prominent part. They are, in fact, the leaders of the fire prevention work in many cities. They carry on intensive inspection campaigns for the purpose of removing hazards; they issue posters and other educational material and deliver addresses upon fire prevention. For the past thirty-seven years, I have been a member of the New York City Fire Department, and its chief for thirteen years. During this period, I have seen the methods of fire extinguishment increase greatly in efficiency, due to improved apparatus, and also, in considerable measure, to the courses given under my direction in the New York City Fire College to which officials of out-of-town departments, as well as local men are admitted.

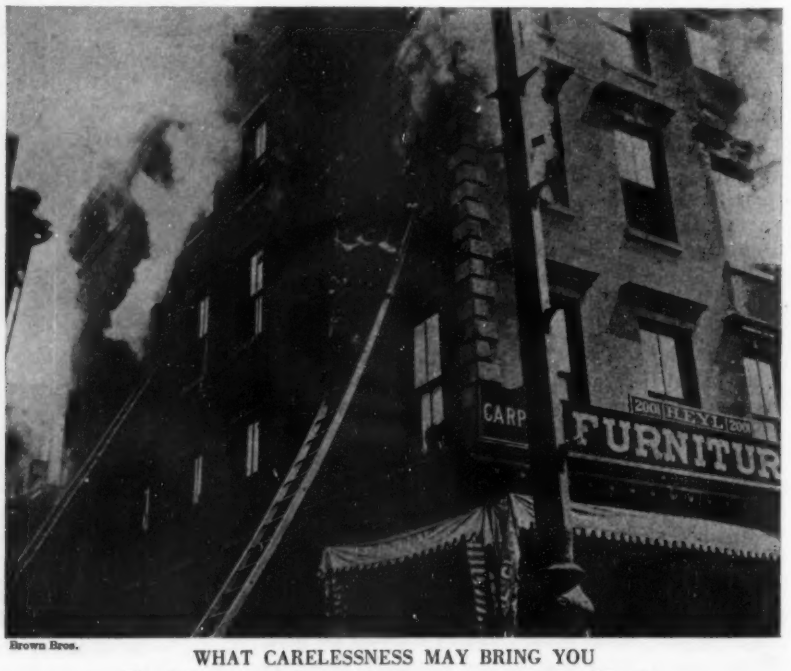
The thought back of the campaign is to "fight fires before they occur." The fire departments are ready and willing to extinguish the many blazes that do take place, but why let matters go so far? A greater knowledge of fire hazards and the exercise of more care in safeguarding them would work wonders in cutting down the fire toll. The fire waste is sapping our economic resources at a rate which even the United States, with all its tremendous wealth, cannot continue without eventually paying the penalty.



Harris & Ewing

HOW THE GOVERNMENT TESTS SHINGLES

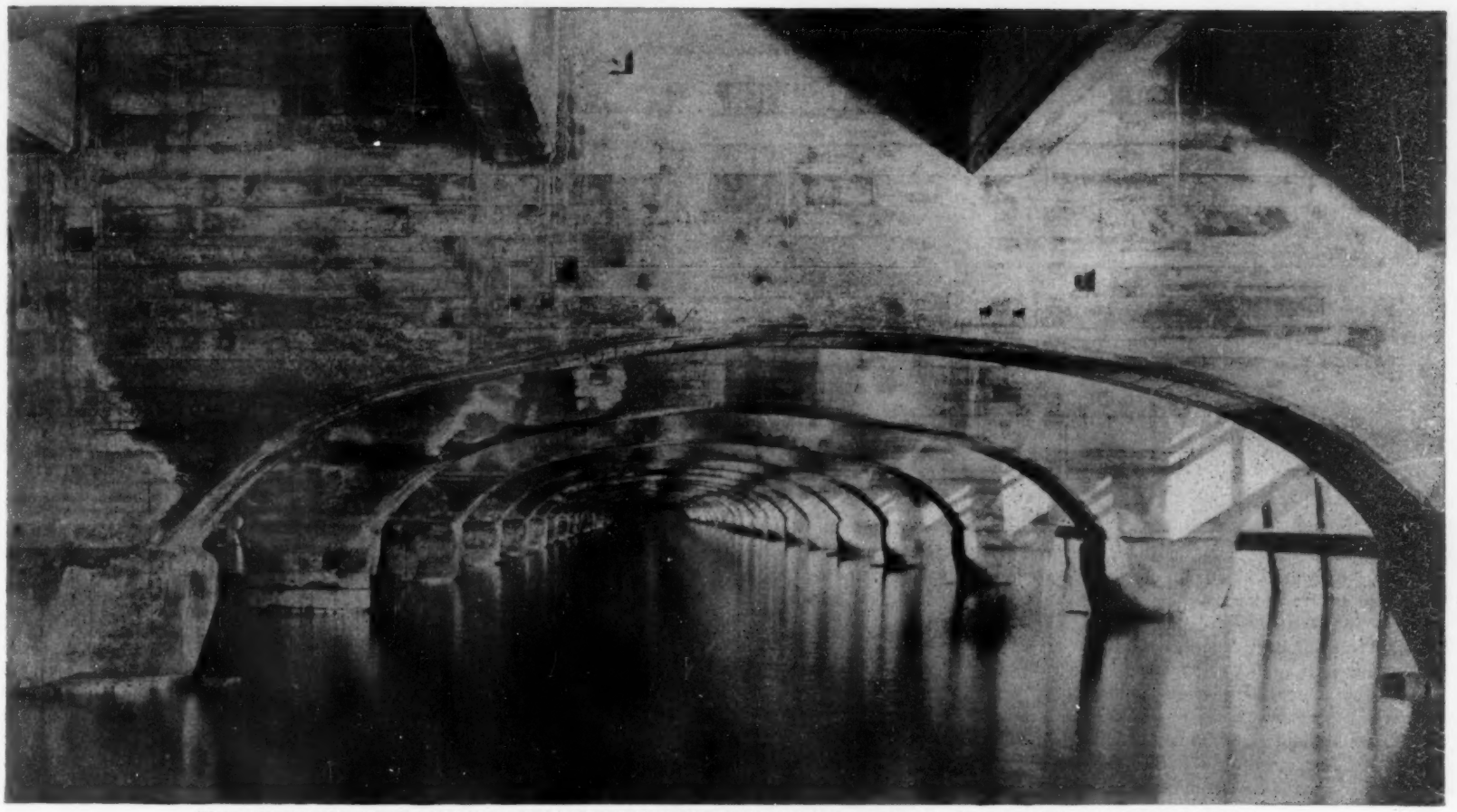
The United States Bureau of Standards is making exhaustive tests of the fire-resisting qualities of different types of roofing



Brown Bros.

WHAT CARELESSNESS MAY BRING YOU

Fire fighters are skilled at rescuing citizens endangered by fire, but how much better to avoid the fire!



THIS VIEW SHOWS THE MASSIVE PRECAST TRANSVERSE GIRDERS AND THE TOPS OF THE BIG CYLINDRICAL PILES

New Concrete Pier at Bremerton Navy Yard

Economy of Combined Precast and Poured Concrete

By J. Bernard Walker

THERE was completed last year at the Bremerton Navy Yard, Washington, a re-enforced concrete pier for the use of warships up to the weight of our heaviest battleships of 30,000 to 40,000 tons, which is worthy of extended notice because of the original and very successful methods of construction adapted. The new work was designed by Mr. W. F. Way, Structural Engineer for Henry and McFee of Seattle, the contractors to whom we are indebted for the photographs and descriptive matter upon which the following article is based.

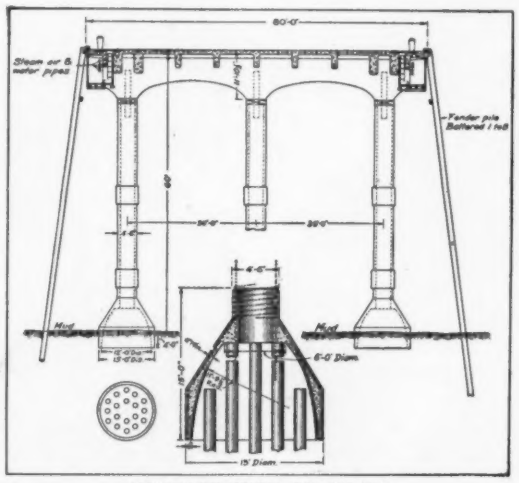
Big Job in Precast Concrete

The new pier No. 5, unlike its predecessor No. 4, in which each bent is built up of four concrete cylinders, has three cylinders to the bent. The deck of the structure is eighty feet wide and its height from the mudline to the top of the deck is about fifty-seven feet. The tide at this point has a rise and fall of fifteen feet.

The novelty and economy of the design are due to the fact that the various members — supporting cylinders, transverse girders, etc.—were precast on shore, and after a sufficient time for hardening were picked up bodily, carried out to the end of the pier and placed in their respective positions.

The problem confronting Mr. Way was to secure in his method of construction a rigidity and stiffness that would be equal to that of a monolithic structure cast on the site within the customary wooden or steel frames.

The cylinders which carry the floor of the structure consist of a bell-shaped base measuring 13 feet in diameter across its lower edge and a cylindrical portion 4 feet 6 inches in external diameter, the total height from base to top of cylinder being 51 feet. Each cylinder was cast in three sections, the concrete being poured with these members in a vertical position. After the concrete was thoroughly cured the sections were connected by short cylindrical lengths 4 feet 4 inches in diameter, which were cast around the joints and of larger diameter than the cylinders, in order to provide unobstructed passage for the concrete filling after the cylinders had been placed in position.



CROSS-SECTION DIAGRAM

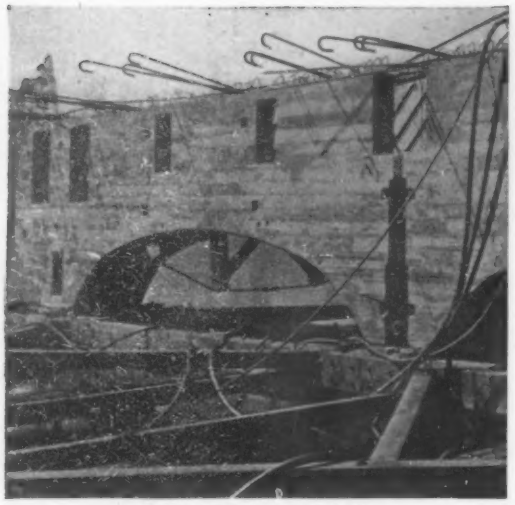
The above drawing shows one of the three-cylinder bents

The bell sections were cast between an inside frame and an outer plate-steel frame, as shown in our illustrations. Other re-enforcement consisted, in the cylinders, of an inside spiral, within which were placed the vertical re-enforcing bars which were wired securely to the spiral. All of the precasting work was done in a yard about 300 feet distant from the pier, and when the concrete of the cylinders and their attached bells was thoroughly cured they were rolled down the ways, carried down a connecting railway, and placed by crane in position at the end of the wharf. It should be mentioned that the hardening of the concrete was hastened by raising the temperature of the liquid concrete to about the heat of the body before it was poured.

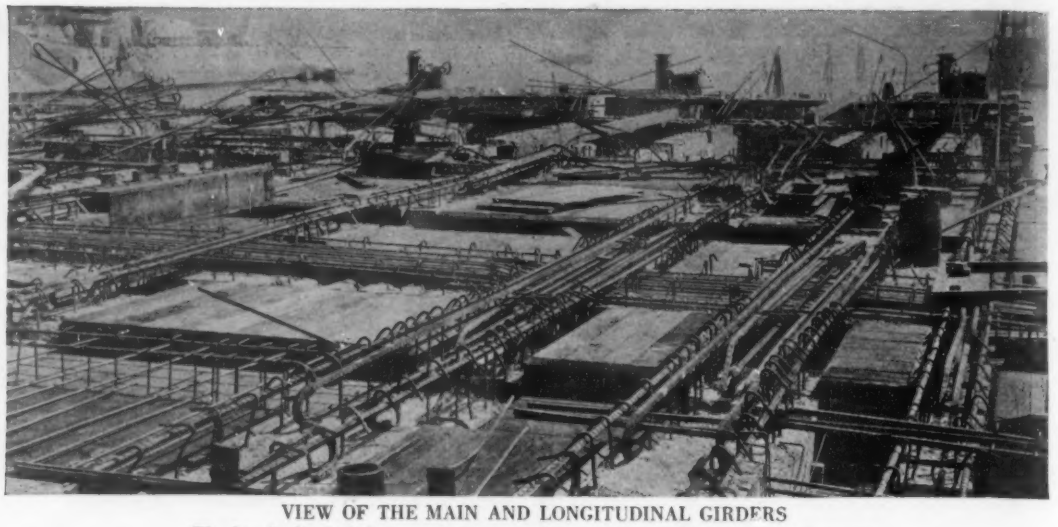
How Uniform Levels Were Secured

In the drawing showing one bent of the pier, it will be noticed that of the cluster of piles driven within the area covered by the bell, three are shown in solid black. These, after driving, were cut off to exact grade, and since great care had been taken to build the precast cylinders with their bells to exact length, the tops of the cylinders required neither filling up nor chipping down to bring them to a uniform grade for the reception of the transverse girders —a most important, constructional consideration.

Mr. Way informs us that the principal feature in his design is the massive transverse girder which



ONE OF THE GIRDERS
These transverse girders are 12 feet in depth over the piers



VIEW OF THE MAIN AND LONGITUDINAL GIRDERS
The longitudinal girders are continuous down the pier. Note the reinforcements

caps and is intimately connected with the three cylinders in each bent. Like the cylindrical piers, these girders are partly precast and subsequently filled in with concrete when they are in place. Each girder, over 72 feet in total length, was formed in two halves, and each span was made up of two precast sides 36 feet long, 12 inches thick, placed on 3-foot centers. Each of these slabs was formed with rather deep diagonal slots along its full length, these slots being on the inside of the slab as assembled, the inside being poured monolithic with the slabs after they had been put in place. Great attention was paid to the junction of these girders with the cylinders and their soffits varied from 6 to 11 feet in depth over the cylinders. To hold them securely in place, a central 16-inch square, lattice, steel dowel was imbedded in the cylinder and ran 7 feet into the poured part of the girder. This lattice dowel was preferred to a precast concrete dowel because it was easier to handle, and by its use it was possible to extend the re-enforcing and the concrete core of the transverse girders continuously through the joints without any break in the continuity of the core.

How Girders Were Built Up

It should be explained that, in working out the stresses, the precast sides of the transverse girders were depended upon to carry the greater part of the dead and live load; but the deep grooves above mentioned on the insides of the slabs, together with a certain interlocking of the stirrup hooks between the sections, served to transfer a portion of the load to the core of poured concrete between the slabs. The longitudinal beams were designed as continuous members, and their location is indicated by the holes shown in the precast girders.

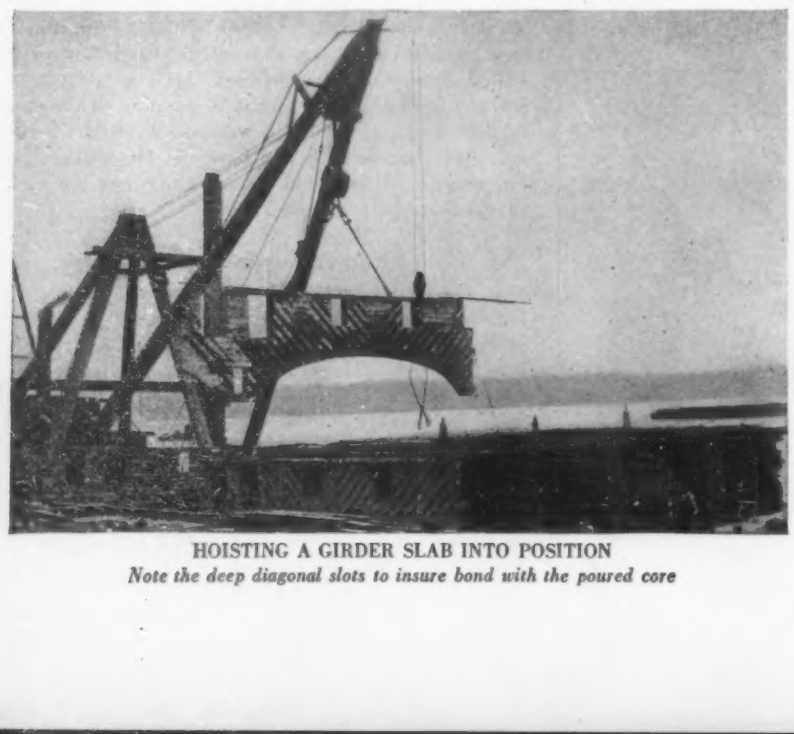
A PRECAST BELL MOUTH
One of the 23-ton bell-shaped bases with cylinder for erection

The quantities of material, both precast and poured, ran to high figures. Thus, there were 7,232 cubic yards of re-enforced concrete of which 4,132 cubic yards were precast, and to fill in the cores of the vertical cylinders required the pouring of 3,157 cubic yards of concrete. There were 72 complete, precast cylinders, each of which weighed 45 tons. Of the three precast pieces in each cylinder, the largest (the bell) weighed 23 tons. There were 96 precast girder sides weighing 20 tons each, and 306 precast beams ranging in weight from 9 to 20 tons each. We draw especial attention to the successful handling of such large precast pieces when they were only from 45 to 72 hours old. So far as we know this has never been done before.

Precasting Eliminated Falsework

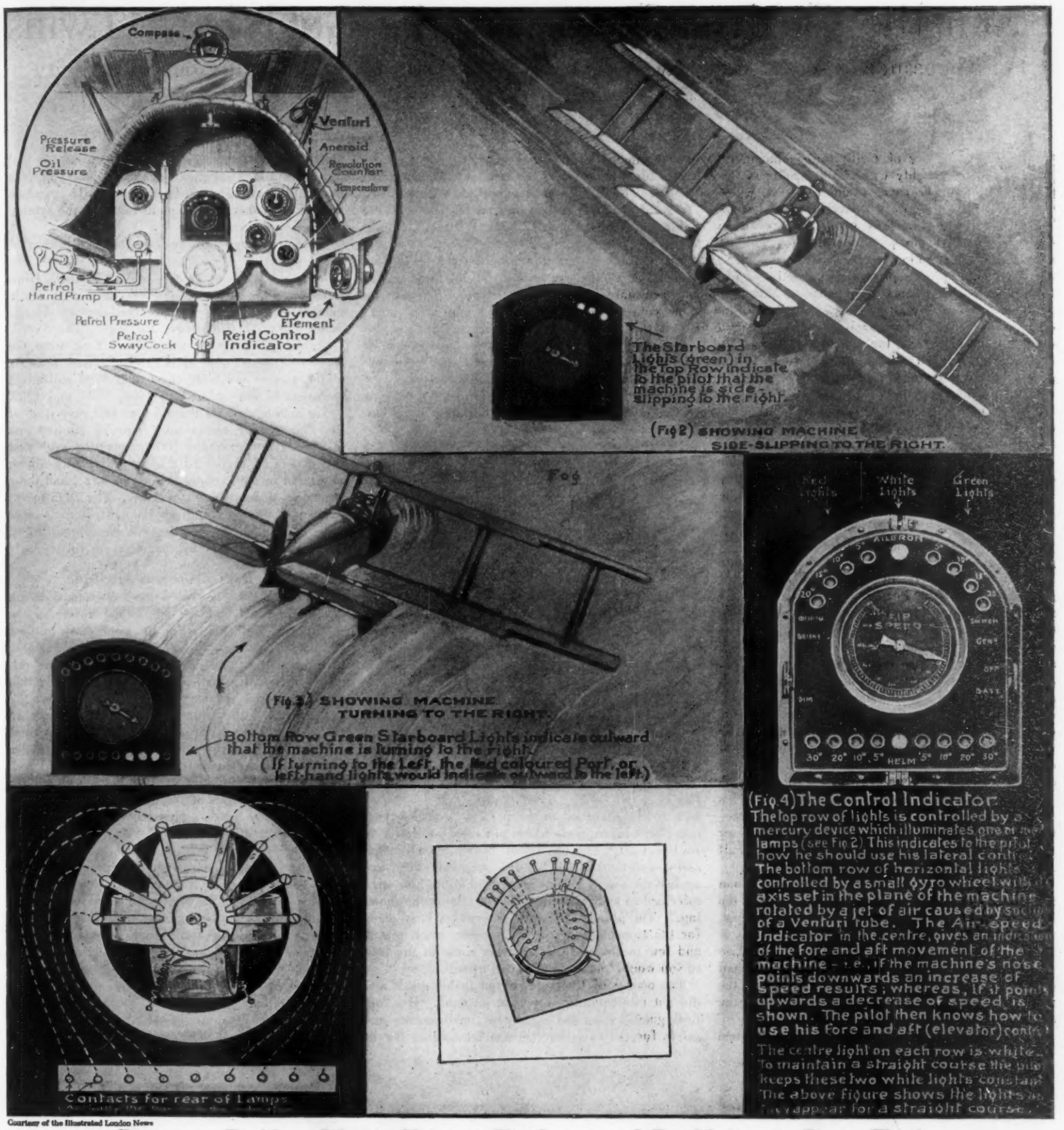
The most interesting feature, from the engineering standpoint, is the method which was used to tie the 718 precast pieces together with steel re-enforcement and combine the precast and the poured concrete in such a way in the structure when on the site as to obtain a pier with sufficient rigidity to serve massive battleships of 30 to 40 thousand tons.

Yet another point which will be of interest to the engineering world is the fact that only six timber piles and 43,000 feet board measure, was used for falsework during construction, and that practically all of this was salvaged at the end of the job. Had the structure been built on the site, the placing of the steel re-enforcement, its proper centering, and the pouring of the concrete, would have necessitated among other things the use of false-work piling 100 feet in length, practically none of which could have been salvaged.



HOISTING A GIRDER SLAB INTO POSITION
Note the deep diagonal slots to insure bond with the poured core

INNER FORMS FOR PRECASTING BELL MOUTH
The bell sections were cast between an inside frame and an outer plate-steel frame



Courtesy of the Illustrated London News

Devices to Enable a Pilot to Maintain His Course and Equilibrium in Foggy Weather

Once the airman has left the ground he is confronted by many enemies, foremost among which is fog. A captain on the bridge of a sea-going liner does not view the descent of a bank of heavy fog with half the misgiving of the pilot of an airplane. Should his compass go wrong on him, he may, without knowing it, stray far from his course; bank too steeply and side-slip, or climb or lose altitude. The ingenious device shown above, designed by Captain G. H. Reid of the Royal Air Force and built by the Vickers firm, provides the pilot with an artificial sense of balance; shows him his degree of inclination during a turn and lets him know whether he is climbing or descending; also, it indicates his speed through the air. Our top left-hand drawing shows the control board with the Reid control indicator located at its centre. In the lower left-hand corner among our pictures will be noticed the gyro with the contacts by which its action flashes up certain green and red lights. The control indicator has two rows of electric lamps, one above and one below the speed indicator dial, which is placed in the centre. The lighting up of the upper series of lamps, which is controlled by a mercury device, tells the pilot how he should use his lateral controls. The bottom row, controlled by the gyroscope, indicates the direction and the degree to which the airplane is turning. In order to maintain a straight course during a fog the pilot keeps the two centre white lights in the upper and lower series constantly in view.

From the Gold of Croesus to the Gold Dust Twins

For Thousands of Years Men Have Used Special Marks to Indicate Quality or Authenticity

By K. A. Campbell
Associate Editor of the Scientific American

THE history of civilization is bound up inextricably with distinguishing marks, as much so as is our alphabet, which is the outward representations or symbols of spoken words. As we scan the ages we find idea-pictures first, long before man had any conception whatsoever of using these idea-pictures as signs representing phonetic sounds. Mason, in his "A History of the Art of Writing," proves that practically all systems of writing can be traced back through the successive stages of development to a primitive age, long anterior to the invention of letters, when all records were merely the pictures of the things or ideas expressed.

It is possible that the earliest peoples may not have had any distinguishing marks which they attached to the crude articles they fabricated, but, not for long; for it seems inevitable that man, even before he could write in crude pictographs, had his own distinguishing marks. We cannot assign any definable marks to articles of the Bronze and the Iron Age, but it seems probable that they had them.

"I Am the Sign of Phanes"

We find, however, that in Lydia, some 700 years B.C., coins were struck in "electrum," an alloy of gold and silver, with the latter predominating. A reference to the illustration will show how crude the effort really was, but, at least, a standard was established. The second coin shown was probably struck at Halicarnassus, in the Sixth Century, B.C., and is the earliest inscribed coin known. On it appears in Greek, "I am the sign of Phanes." We do not know who Phanes was and we do not care, for the idea of proprietorship has been established. The famous Croesus was the first king to mint a gold coin, if it could be called minted, and a man who could make his own coins could easily become wealthy over night. That is how Croesus got his reputation for wealth; but his coins were good—never debased—and we can call him the proud owner of a "trade mark," which stood for quality, as all such marks must do to be of real value.

The various cities of the ancient world soon found the value of having an emblem. Thus, the island of Chios issued coins always having a sphinx, which is still often used for a trade mark. This is much like "Troy Collars," or "Danbury Hats." Two other examples of coins are shown. Some cities had coins calling for the symbol of fertility of the region, such as the ear of barley shown on the coins of Metapontum, in Italy.

There are other marks in profusion when we come into the industrial life of the peoples of classical times; for example, take the wine jar stoppers from Rhodes. The shipper of this good old wine believed "*In Vino Veritas*," and so marked his goods, as we did with "White Horse," "King William," "Bushmills," or "Old Overholt," in the old, pre-Volstead days. Our mints and Assay offices offer gold bars stamped as to fineness, as did the old Romans, for bars are more convenient than coins. The one we show comes from Transylvania, and after being cast it was struck when cold so as to give an idea of its weight, its fineness and who guaranteed all these things. This is exactly what a modern manufacturer does; he stands back of his mark.

When we come to more prosaic articles, such as bricks, we find Nebuchadrezzar building his palace

FIRST REGISTERED TRADE MARK
The first mark to be registered in the United States

with bricks inscribed in the peculiar wedge-shaped, cuneiform inscriptions which are very decorative to say the least. The tile shown comes from London and was so marked. When Julius Caesar waged war against the son of Pompey, the lead sling-shots were inscribed so as to indicate who was "doing the shooting." The plumber of old Rome was a busy man; for the Romans had plenty of water, much piping and few mechanics. He cast his name in the lead so you would know whom to call upon.

The oculist of Rheims believed in his goods and did not mind putting his name on them. His "optical goods" consisted mainly of medicaments and salves for the eyes, but he was an oculist, for he himself says so. Coming down to later times we find those fine old Florentine bankers, the Medici with five balls on their 'scutcheon; two balls somehow got lost and only three remain today as the symbol of the pawnbroker.

Strange to say, the governmental registration of trade marks is a comparatively new thing. The first United States statute was passed in 1870. Illustrated on this page is the crude and unlovely mark, number one, which was registered by the United States Patent Office, October 25, 1870. The Averill Chemical Paint Company of New York were the owners of the "Trade Mark." The salient features of the present law were enacted in 1905 and slight amendments were passed in 1906, 1907 and 1909.

The statute changes the old free and easy days of Croesus. Trade marks must now be studied and watched. For example, it happens this year that two classes of registered trade marks expire—those registered in 1895, under the Act of 1881, and those registered under the Act of 1905. The 1895 marks run for thirty years and the 1905 marks for twenty years. Together they constitute an imposing array of trade marks, many of which are worth fortunes.

The Days of Croesus Are Gone

The Patent Office has ruled that a trade mark which has expired will not be considered a bar in the granting of applications for the same mark applied for thereafter. In other words, if you, as a manufacturer, permit your registration to expire and discontinue using the mark, someone else may have that mark registered and may consider it as his own.

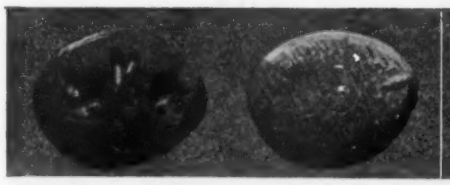
Fortunately, the situation is one which may be taken care of easily, if it is taken care of in time. All that is necessary is to renew the trade mark before it expires, provided it has not been abandoned, and it will be your exclusive property with all the rights and privileges of trade mark registration for another twenty years. This renewal must be done within six months prior to the date of expiration. A number of trade marks are not included in the above category. These are the registrations which were issued after the Act became effective, that is, April 1, 1906, but the applications for which were filed before the law was passed.

The value of some trade marks is almost beyond belief. Take, for example, "Royal Baking Powder," which is worth millions; suppose it was called the "Kitchen Baking Powder," or, suppose "Old Dutch Cleanser" had been called "Climax Cleaning Powder." Such examples show the great utility and value of a well-considered trade mark.

TRADE MARKS THAT ARE WORTH MILLIONS

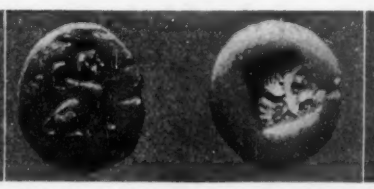
Pictorial slogans that rivet the attention and are never forgotten. Besides the package goods shown, we illustrate the "Ben Franklin" trade mark of the "Saturday Evening Post" and "His Master's Voice" the trade mark of the Victor Talking Machine Company, as well as the famous "Rock of Gibraltar"

Three Thousand Years of Trade Marks



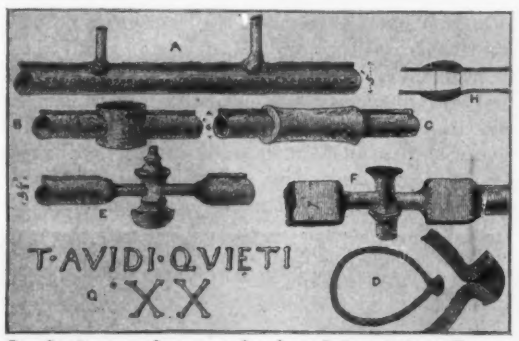
One of the earliest known coins was struck in Lydia about 700 B. C.

This earliest inscribed coin was struck in the sixth Century B. C.

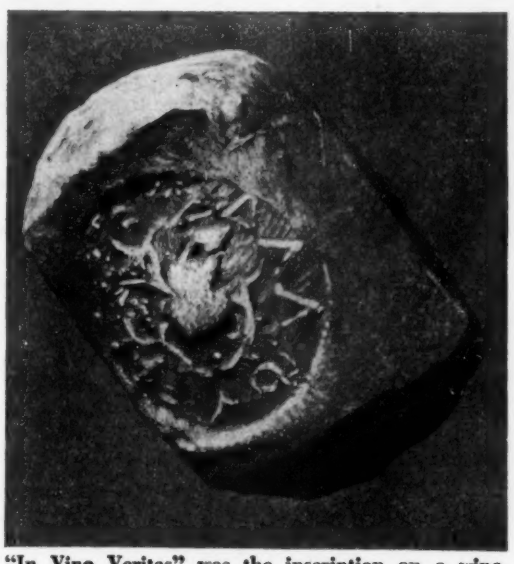


This symbol was used on the coins of ancient Chios

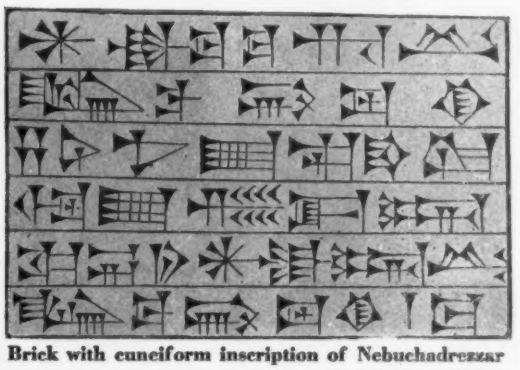
The coins of Metapontum show ears of barley



Lead pipes and turncocks found in ancient Rome with inscriptions giving names and capacities

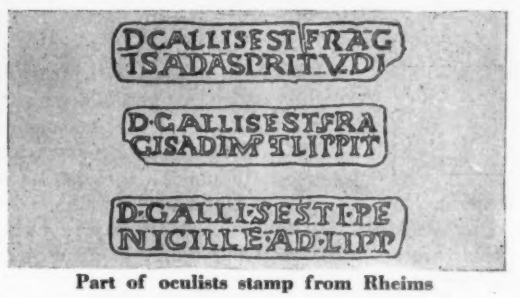


"In Vino Veritas" was the inscription on a wine stopper used by a wine shipper of ancient Rhodes



Brick with cuneiform inscription of Nebuchadrezzar

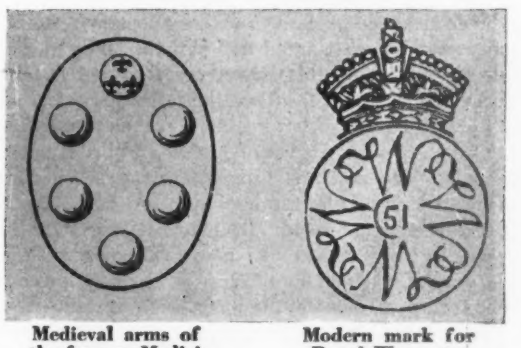
This inscribed sling-shot was used in the war which Caesar waged against the son of Pompey



Part of oculists stamp from Rheims

Marks found on old French Faience

Forli, Italy, 1513. Found on Majolica ware



Medieval arms of the famous Medici family

Modern mark for Royal Worcester Porcelain

Ancient flange tile found in London

Another mark found on Majolica ware

The Athenian coins were known throughout the entire Greek world

Inscribed gold bar found on Transylvania. It dates from the second half of the Fourth Century, A.D. The marks were stamped subsequent to casting

Protection from the Tooth of Time

A Description of the Little-Known Art of Restoring and Preserving Old or Damaged Documents and Prints

By Albert A. Hopkins
Associate Editor of the Scientific American

A BAD JOB
A burned letter or manuscript is very hard to restore, but it can be done

IT is one of the disadvantages of printing or writing on paper that the documents thus produced are not proof against time. With the passage of many years, and especially under the accidents of exposure to sunlight or dampness or to innumerable other domestic misfortunes, historic papers of all kinds are apt to become illegible or to disintegrate altogether.

Mrs. C. H. Lawrence of Brooklyn, New York, is the dean of the profession of documentary restorers, a profession that numbers, perhaps, only a half dozen persons in this country. Mrs Lawrence has been kind enough to allow the Scientific American to describe some of her methods and the results, and to watch the deft fingers of herself and her daughter repair, clean and inlay some of the wrecked documents which it is her profession to restore.

In the past, autograph material was repaired generally by using Japan onion skin paper, which is semi-transparent and, when applied by paste to the torn part, answers the purpose quite well. With gentle handling it will last for years, but climatic conditions may arise which cause it to peel off. Japan paper is seldom used now over handwriting or print. It is still good, however, for mending breaks where it will not be used over writing.

"There are several transparent fabrics," says Mrs. Lawrence, "which have most durable qualities. A piece of one of these fabrics placed over each side of the page is not only transparent, but it is not even visible, except on the closest scrutiny. Every crack and break is held firmly in place by the use of such fabric. Where a lead pencil has been used, the writing often is clearer than before treatment. The age or condition of the document makes little difference, except, of course, that the worse the condition, the more difficult is the task of preserving the document intact. During the last six months I have preserved in this manner, a manuscript of 238 pages which was nearly five hundred years old. The manuscript was on laid paper and the handwriting legible, the major part in old English script and the rest in Latin." Material charred by fire can be salvaged also by the use of this same fabric. In one of the illustrations with this article, Mrs. Lawrence is shown holding a specimen of a burned document which was restored under her deft treatment.

PASTING THE MAP TO THE TISSUE
Pastes of various colors match the tone of the paper

Steel engravings, prints in color and so on, are to be found in many homes. We have all looked upon these prints with fond memories and wished we might have viewed them in their pristine beauty. Unfortunately, this is so seldom possible. Years bring disfigurement. The most common is what is known as "foxing." This is indicated by brown spots, large and small, which show on the face and on the back of the picture. Other disfigurements are due to water stains, to solarization (sun burn) which will show as brown streaks, to carbon stains (if the picture has been through a fire) to oil stains, mildew, iron rust, and so on.

A TOTAL WRECK
A valuable map seems a total loss but can be restored

In the Lincoln engraving, in our illustrations, four kinds of disfiguration are shown, solarization, foxing, water and carbon stains. The second illustration shows the same engraving after having been cleaned. This will give an idea of the remarkable improvement that can be made in a print that seems to be permanently disfigured.

Mrs. Lawrence gives some valuable advice to print owners. "It is quite easy," she says, "to keep prints in their original beauty. Like human beings, they need fresh air and sunshine, but not too much. A print exposed for a very long time to the bright sun will eventually be badly burned. It will lose all the natural strength of the paper through the drying out of the water and oil and the oxidation of the oils and other constituents. Paper that has had too much sun will often crack and break. If you have a valuable engraving or color print hanging where the sun shines on it continually, move it to another spot where it gets the rays of the sun only occasionally.

"The same thing applies to books. It is well to dust your books often and by all means do not have your bookcase near a radiator or heater of any kind."

In the early Eighteenth Century, the Reverend William Granger, of England, conceived the idea that if a print was not large enough for the book in which one wished to place it, it might be inserted by putting a margin around it, thus making it of any desired size. However, if many prints are to be used the mere mounting of them on a sheet of paper of the desired size so increases the thickness of the book as to make it unwieldy for ordinary use. It is necessary, therefore, to attach a margin without making a bulky center. This is done by cutting in the paper mounting a "window" the size of the print and inserting the latter in it.

BEFORE CLEANING
This portrait of Lincoln and his family seemed doomed

Today this process has been so refined that at first glance a good inlay looks little different from a print engraved directly on the sheet of the desired size. The joining of the two papers is done so skilfully that there is practically no increase in the thickness of the paper, even at the joint. The reason for this is that the edges of both the print and the window are beveled, so that when the two are joined the thickness approximates that of the sheet of paper on which the print is inlaid.

AFTER CLEANING
This household favorite restored to its pristine state

This art of inlaying is fast becoming a lost one unfortunately. There are few exponents of this unusual and delicate profession. The necessary skill is not acquired easily or quickly.

The Unusual Occupation of Inlaying Prints

Photographs posed for by Miss Lawrence

Figure 1

TRIMMING THE PRINT

FIGURE 1: *The print is trimmed to a size suitable for inlaying, care being taken to make a well balanced picture. The trimming is done with an exceedingly sharp knife, steel squares and straight edges being used. The actual cutting is done on a sheet of zinc which soon becomes cut by the knife*

Figure 2

MARKING THE PAPER

FIGURE 3: *The next step is to place the print on the sheet of paper to be used, so that it is well balanced with proper margins, and to mark the paper directly at each corner. This is done with a stylus, still using the comparatively soft zinc plate. This operation requires great judgment and skill*

Figure 3

CUTTING THE WINDOW

FIGURE 4: *The window is then cut. The cut is made about one-sixteenth of an inch inside the marks. Care must be taken so that the paper is not cut beyond the pin marks. The slightest faltering is fatal. It seems very easy to the onlooker, but we are assured that it takes great practice and skill before proficiency is attained*

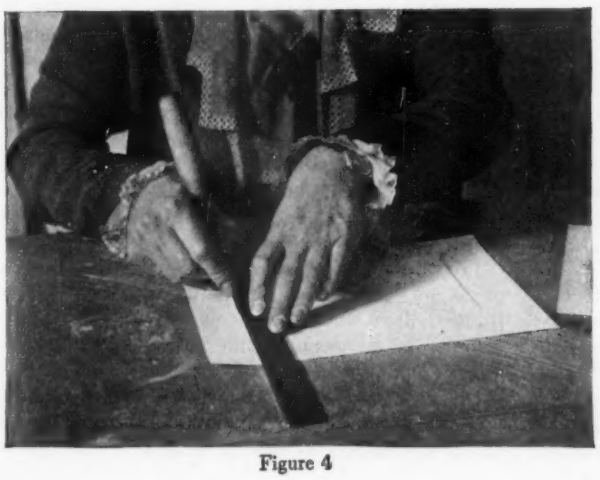


Figure 4

BEVELING THE WINDOW

FIGURE 5: *The window is then beveled in the same manner as the print, although this takes far greater skill, for the utmost care must be taken that the knife does not cut the paper beyond the cut of the window. This operation appears very simple, but the same skill is required as in beveling the print itself, and the space is more confined*

PASTING THE PRINT

FIGURE 6: *The print is then pasted. This is done by using the small sheet made by cutting the window. This sheet is placed on the back of the print, care being taken that the slight margin, one-sixteenth inch, is equal on the four sides. This margin is caused by the fact that in step 4, the cut is made one-sixteenth inch inside the pin marks, thus making the sheet that much smaller than the print*

FITTING PRINT IN WINDOW

FIGURE 7: *The last step is to insert the print in the window, being careful that each corner exactly meets the pin mark made in the third step. The print is then "rubbed in" by the use of a bone paper folder, a sheet of paper being used between the print and the folder to prevent tearing or rubbing the print*

EXAMPLE OF INLAID LETTER

FIGURE 8: *The finished product is now ready for insertion in a book. It is a valuable autograph letter which has been inlaid to go with engraved portraits, landscapes, maps, or other material to illustrate the subject. In view of the value of many letters which are inlaid, it is necessary to give them more than usual care*

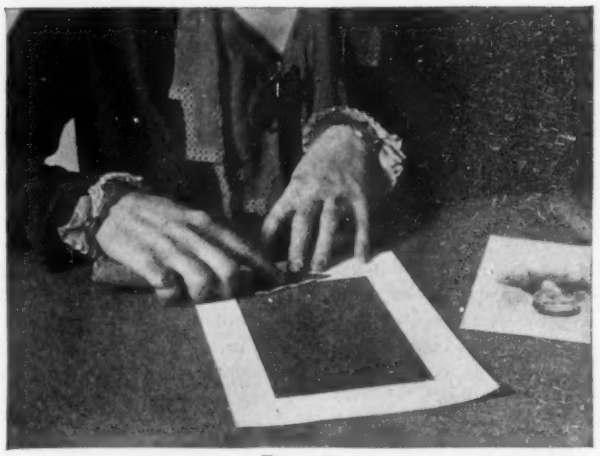


Figure 5

Figure 6

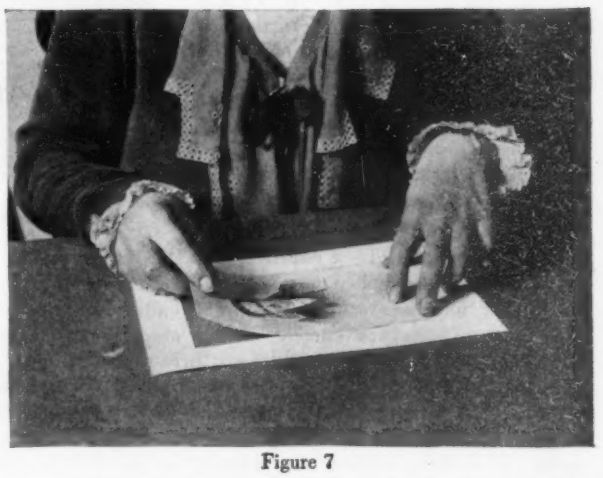


Figure 7

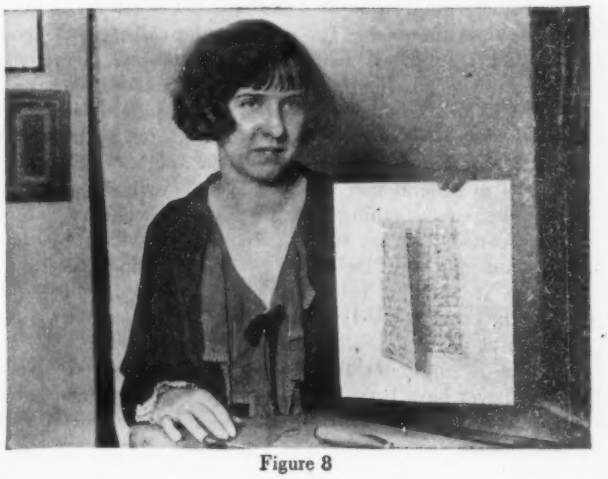


Figure 8

Our Radio Page

The Electric Light Socket and Our Vacuum Tubes

RADIO is entering a new epoch, namely, the substitution of the ubiquitous electric light socket for batteries as a source of current for our vacuum tubes. We are on the verge of developments which have for their object the partial elimination of batteries in most instances, and the total elimination of batteries in a few others.

Ever since popularized radio came into existence, there has been an insistent demand for receivers which would operate on current obtained from the conventional electric light socket in order to escape from the expenses and troubles coincidental to battery operation.

However, the layman fails to realize the technical difficulties in the way of harnessing alternating and direct current to his tubes. He does not understand how sensitive is the vacuum tube and how uneven is the flow of commercial current in comparison with the smooth current delivered by batteries.

Larger Batteries Needed

If the appeal of radio were not so irresistible, the receiving sets would never have developed beyond the crystal detector stage. Indeed, it would have been a foolhardy prediction several years ago to state that some day we would find storage batteries and dry batteries in the living room of our home. Equally foolhardy would have been a prediction to the effect that the average American would spend $5.00 to $10.00 at a time for dry batteries. Yet all that has come to pass. In a single year over $45,000,000 worth of dry batteries and storage batteries have been sold in this country alone.

Since the beginning of popularized radio, engineers have been at work on the problem of lightening the battery burden. Their main line of attack has been the vacuum-tube filament. The first tubes employed were provided with tungsten filaments. They required over one ampere of current at five volts potential for their operation. A storage battery was necessary to supply a current of one ampere per tube. Then, as sets developed into three-tube sets and the current consumption for the filaments increased to three amperes and over, the battery had to be increased in size so as to provide a satisfactory source of current without the necessity of too frequent recharging.

When the time came for new circuits calling for five tubes, engineers had already developed new filament materials for reducing the current consumption. The first of these economical tubes were those with the so-called oxide-coated filaments, such as the WD-11 and WD-12 radiotrons. These tubes, which are still in general use, require .25 ampere at about 1¼ volts, or something like .30 watt. Then came the thoriated filament tubes, such as the UV-201-A radiotron and the DeForest DV-3, requiring .25 ampere at about 5 volts, or 1.25 watts, and still later the small UV-199 radiotron, requiring .06 ampere at 3 volts, or .18 watt.

There is no doubt that the multi-tube receivers would never have been feasible except for the later-day vacuum tubes with their economical current consumption.

The Joker in This

There is a joker in all this vacuum-tube business, however, which has gone unnoticed in most instances. That is the increasing burden placed on the "B" or plate batteries. While attention has been focused on lightening the burden placed on the filament batteries despite the increasing number of vacuum tubes to each set, we have done very little to reduce the consumption of "B" battery energy per tube. Today, with the five-tube sets in such general use, the "B" battery is required to furnish a current of many milliamperes. The consequence is that our "B" batteries fail to stand up as they formerly did. Many of us blame the battery manufacturer, whereas, all the while, we are draining our "B" batteries twice or three times faster than we did before.

Battery manufacturers have endeavored to keep abreast of these developments. Manufacturers have put out extra-sized "B" batteries. The so-called twin dry cells, with increased zinc surface for greater current capacity, have been brought out for radio purposes. And of late the storage battery manufacturers, sensing the steadily mounting "B" battery drain, have brought out special storage batteries of low amperage and high voltage characteristics.

F. M. Delano

A RADIO STATION IN MINIATURE

Giving a demonstration of the model of the Bordeaux-Lafayette radio station to Mr. F. M. Delano, Paris correspondent of the Scientific American, at the radio fair in Paris

Just so long as we are contented with the flivvers of radio—the little one, two, or three-tube dry-cell receivers—the operating cost is of no great concern even to those with modest purses. But as we reach up to the five-tube, six-tube and eight-tube receivers, the cost of dry-battery operation mounts by leaps and bounds. Some measure of relief has been obtained through the use of a "C" or grid-biasing battery. Not only does this extra battery, consisting of two or three small cells of dry battery, sweeten the tone of the receiver, but it materially cuts down the drain on the "B" battery.

As a general rule a storage battery is more economical to operate than the equivalent dry battery. For this reason many of the dry-battery receiving sets are now being operated with storage batteries, despite the inconvenience of recharging.

But if operating expense is to become a main issue in radio reception, we must come to the commercial lighting current—the nearest electric light socket—as a source of current for our vacuum tubes. At first this was merely an ultimate ideal. Today it is almost an immediate necessity.

In applying the usual lighting current to vacuum tubes, we are confronted with numerous and serious obstacles. There is considerably more to the problem than the mere reduction or stepping down of the current to the low potentials required by the usual vacuum tube. A transformer would take care of that end with little or no trouble. There is still more to the problem than the conversion of alternating current into direct current—a simple rectifier would attend to that. Where the real obstacle comes in is in the elimination of the troublesome hum found in all commercial lighting currents.

This hum, which must not be permitted to reach the loudspeaker or telephones, is due to irregularities in the lighting current which go by quite unnoticed in regular light and power practice, but would be magnified by our vacuum tubes to the point of serious interference.

After several years of experimentation, radio engineers have finally evolved several broad methods of harnessing lighting current to the operation of our vacuum tubes. The methods call for transformers with center taps, special potentiometers, filter circuits, vacuum-tube rectifiers the output of which is smoothed out by high-value inductances and capacities, chemical rectifiers and other miscellaneous apparatus.

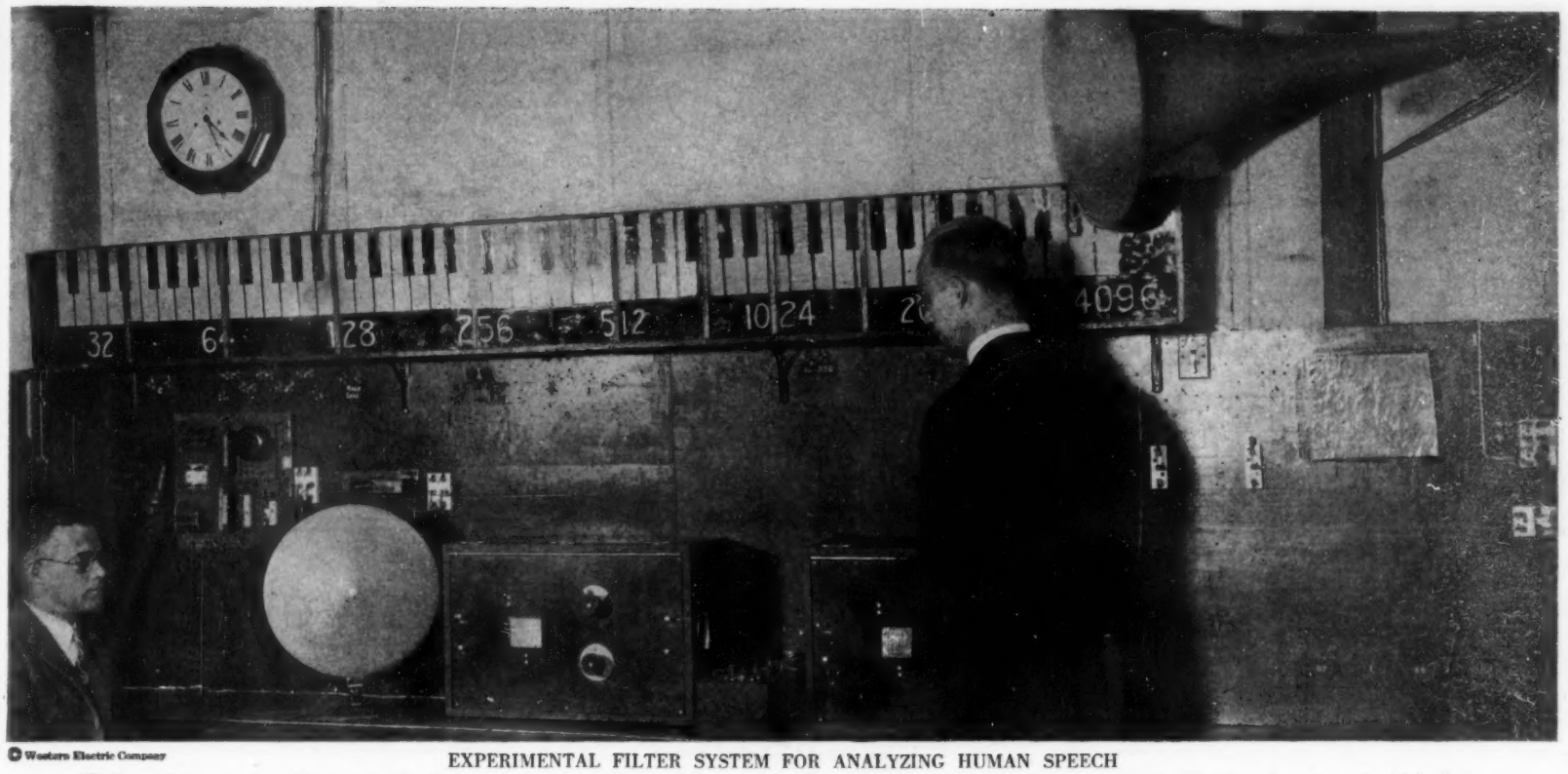
Many Experimental Devices

It is considerably simpler to harness direct current than alternating current. In the case of direct current a simple resistance arrangement serves to reduce the current to the proper voltage, while an arrangement of resistances and filters serves to eliminate the "ripples" caused by the commutator of the generator supplying the current. In fact, direct current presents so much less of a problem that already we have several kinds of receiving sets operating directly from an electric light socket without the use of batteries of any kind.

When it comes to alternating current, the problem is more difficult. There are several offerings now on the market which serve to replace the usual "B" battery, but do not attempt to operate the filaments of the vacuum tubes. It is admitted by radio engineers that the "B" battery substitute is considerably easier to solve than the filament or "A" battery. Hence, the majority of the devices now available aim only to replace the "B" battery.

The "B" battery substitutes generally take the form of a step-down transformer, a vacuum tube operating as a rectifier, a choke coil and filter condensers. Some of the devices now being marketed require special rectifier tubes, while others take the standard vacuum tubes.

Progress is being made towards operating the filaments on commercial alternating lighting current. In fact, there are experimental devices which will operate the filaments of the radio-frequency tubes and the audio-frequency tubes, but not the detector. In such instances the detector must either be a crystal detector, or a vacuum-tube detector operating on dry battery or storage battery.



© Western Electric Company

EXPERIMENTAL FILTER SYSTEM FOR ANALYZING HUMAN SPEECH

The large boxes on the table contain the high-pass and low-pass filters. On the wall above is the loudspeaker and an indicator the illuminated sections of which show what frequencies are being transmitted

Electric Filters that Illustrate Defects of Radio Loudspeakers

By Paul B. Findley, E.E.

Bell Telephone Laboratories, Incorporated, New York City

MANY radio fans have accepted as inevitable the "tinny" reproduction of piano music given by their loudspeakers. In fact, many would-be listeners of discriminating ear have not taken an active interest in radio because of this and other defects which they have observed in the quality of reproduction displayed by some receiving sets.

One of the reasons why many radio reproductions fall short is that the range of pitches reproduced is not wide enough. To a musician, pitch means the shrillness or lowness of a tone; its place in the musical scale or on the keyboard of the piano. But to a physicist, pitch means the number of vibrations a second. All sounds consist, you remember, of vibrations in the air or in something else, which vibrations are transmitted to the nerve endings inside your ear so that a sensation is produced. A low tone is one of relatively few vibrations a second; a high, shrill tone has many vibrations a second.

Middle C on the piano has, for example, 256 vibrations a second. If the sound entering your ear makes exactly 256 little separate pushes against your ear-drum in one second, then you experience the sensation which a musician will identify as the sound of middle C. The physicist's name for a vibration is a "cycle," so middle C is known physically as a 256-cycle note.

Now, for the proper reproduction of miscellaneous sounds, the radio set or loudspeaker or other device must be capable of letting through all the pitches over a considerable range. Even fairly good transmission of speech requires that tones from about 100 cycles to about 3,000 cycles per second be rendered with substantially equal efficiency. For music the range should be extended down to 50 cycles and up to 5,000 cycles. When any part of this range is cut off, the quality of the music or of the speech may be spoiled. Just how this happens is well illustrated by some experiments performed by Dr. Harvey Fletcher of New York City.

In the course of his investigations into human hearing, carried on in the Bell Telephone Laboratories of the American Telephone and Telegraph Company, and the Western Electric Company, Dr. Fletcher made use of an experimental telephone system which normally reproduced sounds with equal efficiency over a wide range of pitches. But included in this system are two networks of coils and condensers called electric filters. One, the *low-pass* filter will pass all electric currents which have *less* than a number of cycles a second. The other, the *high-pass* filter will pass all currents of *above* a certain number of cycles a second.

Higher Toned Instruments More Life-Like

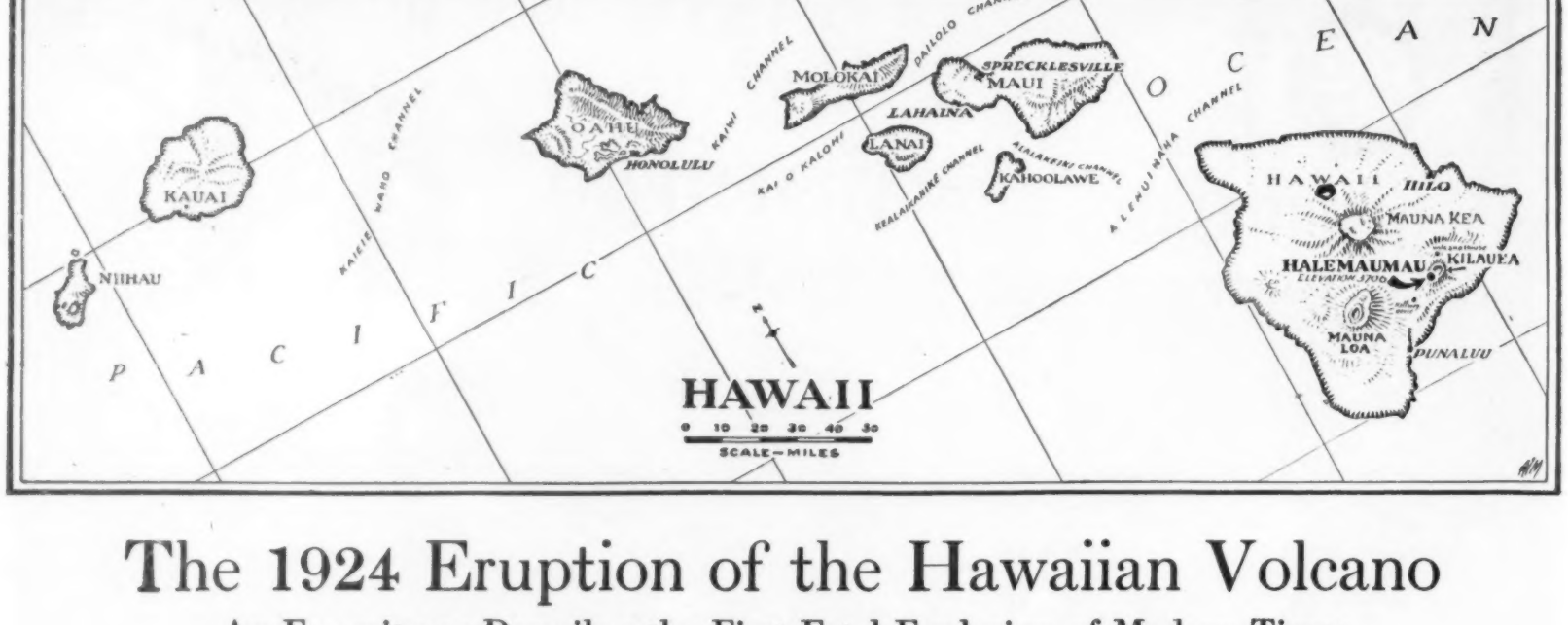
On listening to a speaker while more and more of the low tones are suppressed, the voice rapidly grows less and less natural. Intelligibility, however, suffers less. It is possible to understand the speaker even after the qualities of pitch and timbre, by which chiefly we recognize a voice, have disappeared. But, if on the other hand, the higher tones are cut off progressively by other filters, more and more of the words are misunderstood. Intelligibility suffers, but the speaker's voice, although changed, is still easily recognizable.

The results of using the filters with music are equally impressive. The low C of a piano is a tone of 64 cycles a second. When this key is struck there is a great change in quality if all the tones below 250 cycles are cut off. If all tones below 500 cycles are cut off the tone becomes metallic. If all below 1,500 cycles are eliminated the tone sounds "clanging." Yet, in spite of these changes, the apparent pitch of the tone remains unchanged.

This is the explanation. When you strike a piano key you send off sound waves, the main pitch of which is that to which the string inside the piano is tuned. This note is called the fundamental. Also you send off other sound waves at twice, three times, four times, and so on, the number of cycles in the fundamental. These are called the first, second, third, and so on, harmonics.

And it is these harmonics which make it possible for your ear to recreate the tones that your loudspeaker does not give out. For, suppose that the fundamental and the first two harmonics of the piano note mentioned are suppressed by some deficiency of the apparatus, you still have 16 harmonics left. From them the ear makes up a tone recognizable as the proper note.

Of course, the notes from some orchestral instruments are transmitted by wire and radio better than those from others. In general, the higher toned instruments sound more life-like. Deep toned ones, like the piano or organ and kettle drums, fare worst. In his lectures, Dr. Fletcher demonstrates the effect of cutting the low tones out of music. After this demonstration it is not difficult to guess why so many loudspeaker installations are falling down. With voices, it is curious that a male voice is injured more than a female voice by cutting off the transmitted tones above the same point. The richness of a man's voice comes from the presence of harmonics, while the pure notes from a woman's throat indicate the lack of important harmonics in the tone region cut off by the electric filters.



The 1924 Eruption of the Hawaiian Volcano

An Eye-witness Describes the First Fatal Explosion of Modern Times

By Harold T. Stearns
United States Geological Survey

TREMENDOUS scientific and spectacular interest attaches to the explosions at Kilauea Volcano in Hawaii National Park, in May, 1924, for this series of explosions is the first ever witnessed by white men at Kilauea.

In 1790 there was a similar series of eruptions, although evidently a more violent one, which Dr. James D. Dana has recorded. "The account of the eruption of 1789," he says, "was gathered from the natives by the Rev. I. Dibble, and published in his 'History of the Sandwich Islands' at Lahainaluna, in 1843. It was taken by the author from the lips of those who were part of the company and present at the scene, and is as follows:

"The army of Keoua, a Hawaiian chief, being pursued by Kamehameha, were at the time near Kilauea. For two preceding nights there had been eruptions, with ejections of stones and cinders. The army of Keoua set out on their way in three different companies. The company in advance had not proceeded far before the ground began to shake and rock beneath their feet, and it became quite impossible to stand. Soon a dense cloud of darkness was seen to rise out of the crater, and almost at the same instant, the thunder began to roar in the heavens and the lightning to flash. It continued to ascend and spread around till the whole region was enveloped, and the light of day was entirely excluded.

"The darkness was the more terrific, being made visible by an awful glare from streams of red and blue light, variously combined through the action of the fires of the pit and the flashes of lightning above. Soon followed an immense volume of sand and cinders, which were thrown to a great height, and came down in a destructive shower for many miles around. A few of the forward company were burned to death by the sand, and all of them experienced a suffocating sensation.

A Collection of Corpses

"The rear company which was nearest the volcano at the time, suffered little injury; and after the earthquake and shower of sand had passed over, hastened on to greet their comrades ahead on their escape from so imminent peril. But what was their surprise and consternation to find the center company a collection of corpses. Some were lying down, and others were sitting upright, clasping with dying grasp their wives and children, and joining noses (the mode of expressing affection) as in the act of taking leave. So much like life they looked that at first they supposed them merely at rest, and it was not until they had come up to them and handled them that they could detect their mistake."

Halemaumau, the lava lake of Kilauea, the famous "Pit of Everlasting Fire," is located near the southwest end of the crater floor, and is the main vent in Kilauea. Prior to the eruptions of May, 1924, the lava lake had gradually subsided until the lava disappeared from sight on February 21st, leaving a pit 380 feet deep. This pit remained empty of lava from February 21st on, and was exceedingly quiet until April 29th when large amounts of dust began to rise from it. The walls of the pit began to avalanche, causing slight earth tremors in the vicinity of the crater, and the rock dust resulting from these avalanches rose as small dust clouds. This stage continued until the night of May 10th, when occurred the first explosion which threw out rocks. On Saturday night, May 10th, or early on Sunday morning, May 11th, a sudden explosion took place in Halemaumau. It lasted only a few minutes and the vol-

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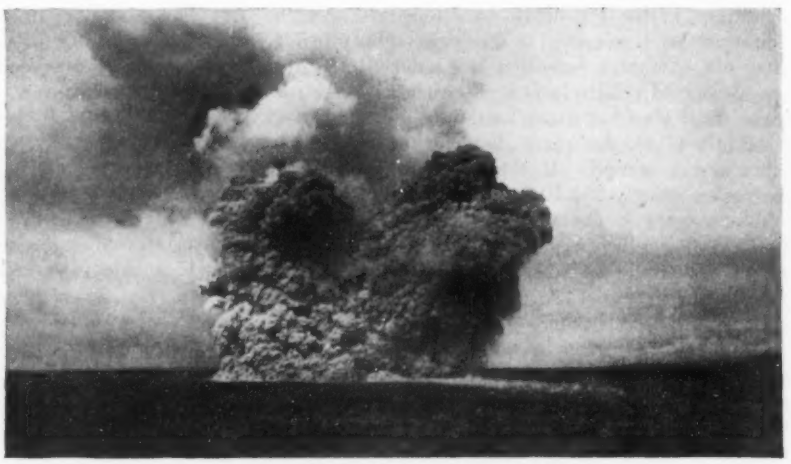
GIGANTIC ROCK THROWN FROM VOLCANO
This ten-ton block was thrown to the aviation field, 3,500 feet from the center of the pit



CLOUD ABOUT TEN SECONDS OLD
View taken from Volcano Observatory about two miles from scene of explosion. Note rocks showering down

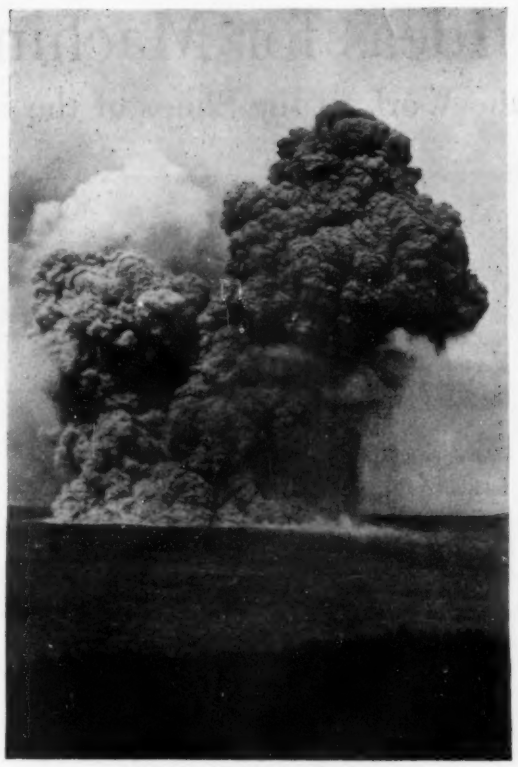
cano again returned to a condition of steaming, avalanching, and forming of dust clouds. The avalanches and dust clouds, however, were much larger and more continuous than before and minor explosions continued at frequent intervals until Sunday morning, May 18th.

On that morning about 10:30 A.M., occurred the only tragedy of the eruption. Mr. Trueman A. Taylor, of Pahala, approached the rim to take photographs of the dust cloud, which at this time rose about one to two thousand feet into the air. Suddenly a terrific explosion took place. A dense cloud of dust rose vertically out of the pit, bringing with it thousands of red hot blocks of rock, and tons of smaller debris and dust. Probably within forty-five seconds these rocks were showering down in the vicinity of Taylor, who had reached a point about 1,800 feet from the old rim. One of them crushed both his legs. Friends who were farther from the pit succeeded in reaching an automobile they had left nearby with the engine running. Not knowing what had happened they waited a few moments for Taylor, but rocks began to fall through the top of the car and they were compelled to flee.

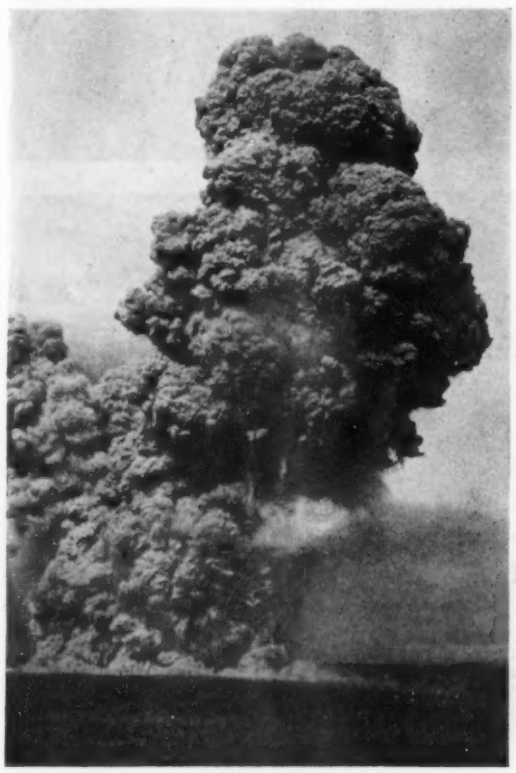
The Rescue Accomplished

About three-quarters of an hour elapsed before the rain of rocks abated so that a searching party could reach Halemaumau and look for Taylor. The searchers found Taylor in a pitiful condition smeared with hot mud and with burns from hot dust and sand, lying fifty feet from where he had fallen. The rescuers applied first aid but before they had completed their work, the wrath of the volcano was aroused once more. Another terrific eruption began, hurling out rocks, and sending a dust cloud over two miles into the air. Although showered with mud and rocks the rescuers succeeded in carrying Taylor to safety. This was the fifth explosion of Kilauea that day.

Taylor was conscious when found and said that he had been so ever since he was first hit. He even tried to joke a little and remarked that there was a fine picture in his camera. But his injuries had been too severe. He died that night as a result of internal hemorrhages. Thus did Kilauea take her first toll of human life since she was discovered by white man.



TWENTY SECONDS LATER
The dust column was then about 4,000 feet high. Note cloud drifting by



THIRTY SECONDS LATER
The dust column one minute after beginning of eruption. Now about 7,000 feet high

On May 11th, Superintendent Boles of the Hawaii National Park closed the road 2,000 feet from Halemaumau and restricted all visitors, except the scientists, to that limit. On the 13th the road was closed at one mile, and on the 16th at two miles from the pit. Only one permission was granted anyone to go to the rim of Halemaumau. A native Hawaiian Kahuna, or priest, was allowed to ride horseback into the danger zone in order that he might sacrifice a twig of chello berries to appease the wrath of the native goddess, Madame Pele, who is supposed to dwell in the volcano. The Hawaiian people, in spite of their long contact with more modern ideas, still cling to a considerable faith in sacrifices to Madame Pele. They all avow that, in 1881, it was nothing but the sacrifice of a live pig to the goddess that stopped the lava flow from destroying Hilo, the principal city on the Island of Hawaii.

At 8:07 A.M. on May 22d, the Volcano Observatory, about two miles from Halemaumau but on the rim of the outer crater, was set into vibration by an earthquake. At 8:10 A.M., only three minutes later, a cauliflower-shaped cloud indicating an explosion began to rise from the pit of Halemaumau. With it came a large number of rocks. Before the cloud was ten seconds old one could plainly see the rocks falling on the north side of the pit. Indeed, the continual rain of rocks upon the lava surrounding the crater caused a noise that could be heard distinctly at the observatory.

As soon as the explosions were over a number of us went down to the pit to examine the effects. Three miles from the pit we ran into a rainstorm caused by the explosion. But instead of rain we received a shower of mud pellets, or pisolites, which covered everything with ash.

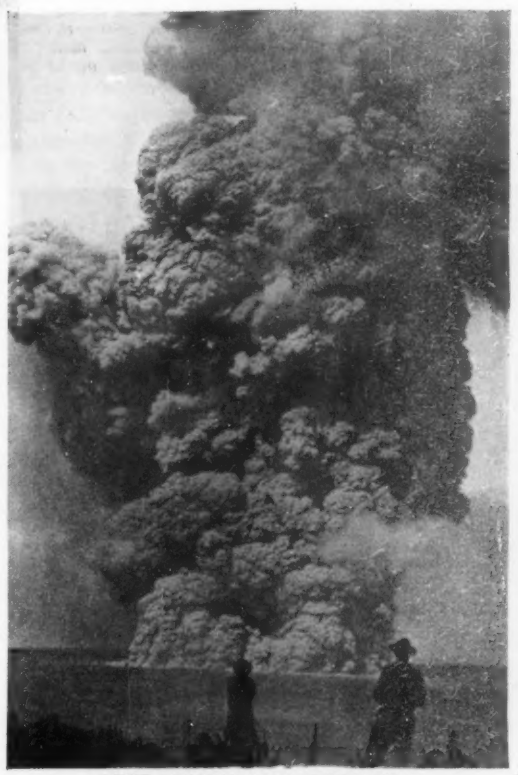
The aviation field, two thousand feet from the rim of Halemaumau and which had been cleared of the rocks thrown out by the 1790 eruption, was now strewn thickly with great blocks of rock and was pitted by their fall. It looked quite similar, indeed, to the bombed battlefields of France, for the pits made by the falling blocks ranged from one foot in diameter and four inches deep to large holes ten feet across and three feet deep.

On May 25th, Mr. W. O. Clark and the writer rode up the side of Mauna Loa from the village of Pahala. At an elevation of 1,900 feet and about twenty miles southwest of Kilauea crater, we ran into a dense cloud of dust from Kilauea, this having resulted from an explosion of about a half hour before. Sharp sand, about one-fiftieth of an inch in diameter, showered down on us stinging our hands and faces. It fell so rapidly that it would slide down the wrinkles of our clothing in continuous streams. It was impossible to see a building 150 feet away and people who passed by us were carrying lanterns, so thick was the dust. Needless to say we made haste to ride crosswise to the shower and get out of the thickest of it. During the previous week the fall of ash had amounted to one-thirty-second inch every twenty-four hours at Pahala.

Lava Came Back in the Pit

By May 26th the explosive force had spent itself sufficiently so that it was possible to approach the rim of Halemaumau with some confidence. The bottom of the pit was 1,300 feet below the rim and consisted of slopes of loose rock fallen from the walls. Steam rose in many places through this loose material but no liquid lava was in sight. About noon on July 19th the lava came back into the pit. It broke through the loose rock on the west side in a fiery fountain more than a hundred feet high. The flow formed a pool of lava in the bottom of the pit.

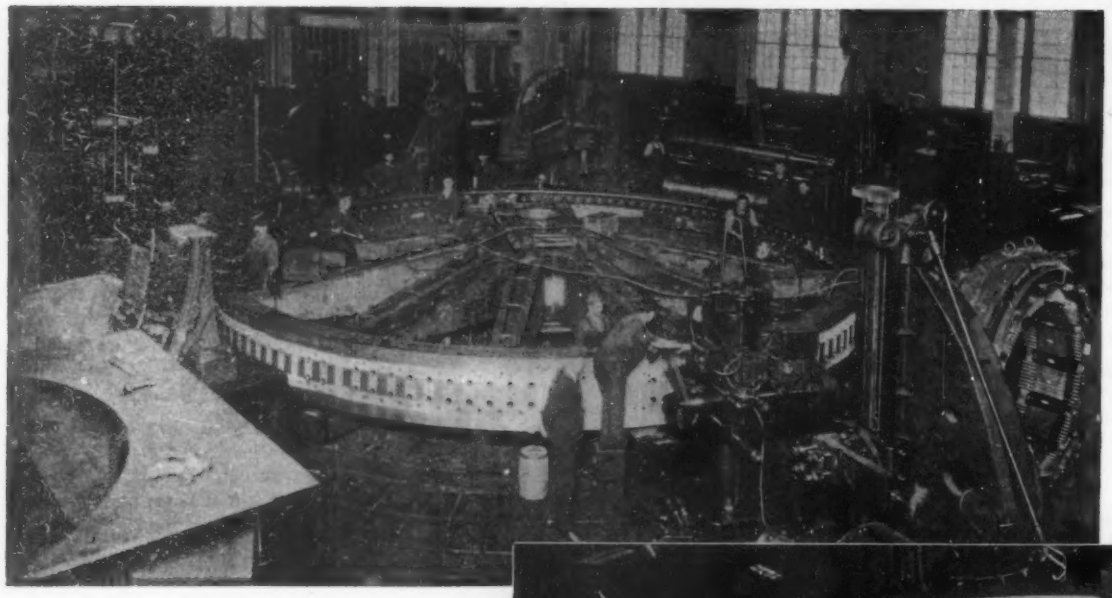
Why it is that the normal, lava-filled condition of the pit is varied once in a while by explosive eruptions is still unknown. The cause may be the seepage of water in from the ocean or downward from the surface and the ultimate contact of this water with red hot lava underneath. Or the explosions may be due to gases in the lava; all of the lavas discharged from Kilauea having been more or less gasey, as their vesicular, frothy appearance indicates. The cause of the explosions must be an unusual one, the explosions of 1790 and of 1924 having been the only ones recorded in the volcano's history.



DUST COLUMN 11,000 FEET HIGH
View about a minute and three quarters after the beginning of the eruption

Modern Ideas for Machine Shops

Moving the Machines to the Work in the Shops of the General Electric Company



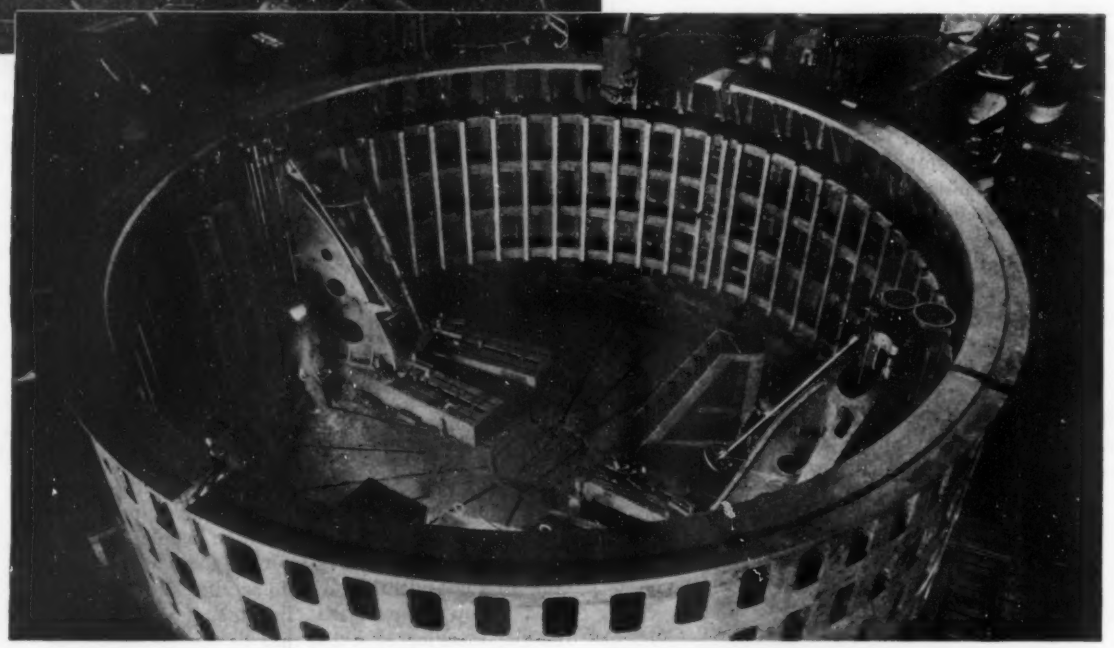
Note the numerous machines around this work, many different milling operations being performed at the same time. All of these tools are moved to the work by cranes. The huge "spiders" are mounted on a turn-table and revolve against the machine tools

IN some of the largest machine shops in the world, located at Schenectady, N. Y., the electrical generators and turbines are so large that the tools which work on the steel and iron are moved to the work, rather than transporting the work to the machines.

The two upper views show the stationary and one of the moving parts of a huge 65,000 kilowatt generator, which is now in service at Niagara Falls.

In some of the shops of this company, a man is relatively small compared to the huge tools which are necessary to build electrical equipment.

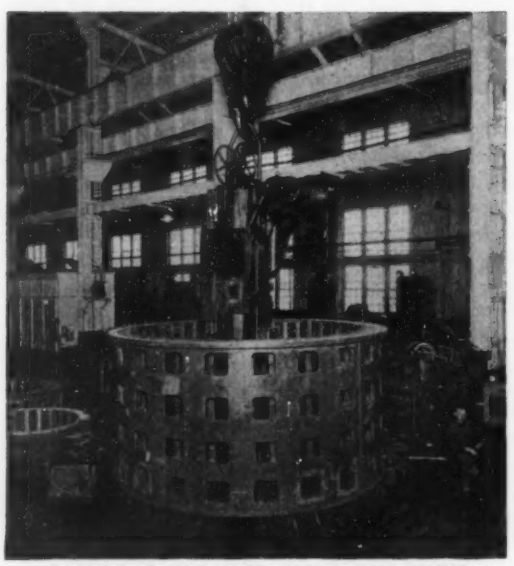
The smaller machine tools are located in galleries around the great erecting shops. Cranes of various lifting powers run one under the other performing mighty tasks suitable to their strength.



Working inside a great generator-frame with vertical milling machines. The castings are held stationary while the two milling machines can be moved to the next section of the casting by turning the circular floor-section. After the tools have performed their work they are hoisted out of the way

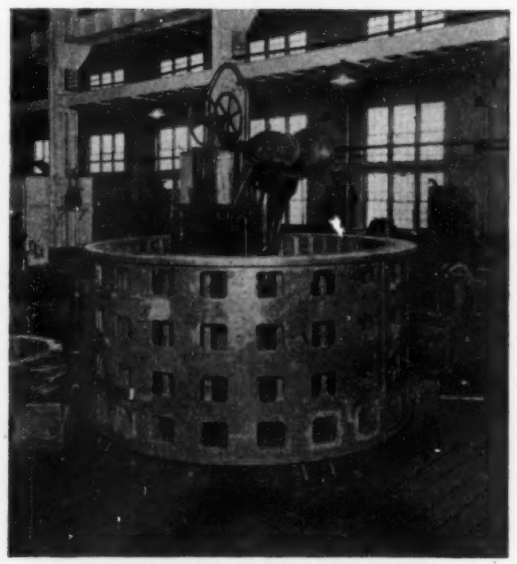
THE GREAT TOOL ON ITS WAY

A machine is suspended in the air on its way to the large generator-frame on the right on which it is to be put to work. Some idea of the vast size of the erecting shop may be had from the hugeness of the travelling cranes



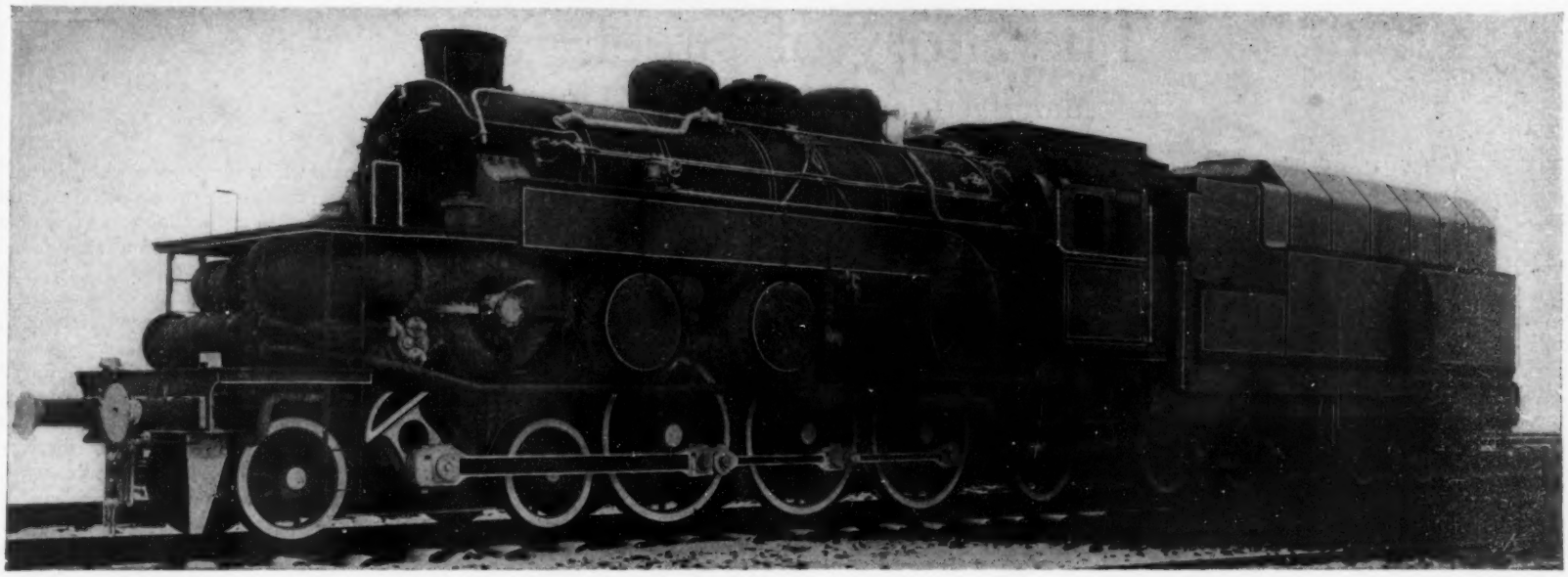
LOWERING THE TOOL INSIDE THE WORK

In this illustration a machine is just being placed inside the generator-frame. The travelling cranes transport the rough castings as well as the machine tools, and take away the finished part and the tools when the work is completed



THE MACHINE READY FOR WORK

Machine inside the generator-shell ready for work. Note the slotted floor to which both machine tools and castings can be secured. For convenience in handling the tools are provided with great handles or "bails"



The Krupp Turbine Locomotive

THE successful application of electric traction to several of our main-line steam railroads during the past two decades has led many writers to the precipitate statement that the steam locomotive is "doomed." One of the strongest criticisms of the locomotive was based upon the fact that it was an extravagant user of fuel and that the consumption per horsepower per hour ran as high as six to eight pounds. One result of this criticism has been to stimulate locomotive builders to devise ways and means by which the coal consumption could be cut down to a more reasonable figure. As we have recently pointed out in these columns, excellent economies have been realized by the use of super-heated steam, by compounding and by the building of multi-cylinder, high-pressure locomotives. Another line of attack and, so far as reduction of the coal bill is concerned, the most promising, is the substitution of the steam turbine for the reciprocating engine.

We now present illustrations of a turbine locomotive which has recently been built by the Krupp works at Essen. The claims for economy in this machine are modest, the company announcing a reduction of only twenty percent in fuel consumption; but when it is remembered that before the war the German railroads spent about 230,000,000 gold marks for the coal necessary for their locomotives, it is clear that should the new machine establish its all-round efficiency and become generally adopted, the total saving will run to a very large figure.

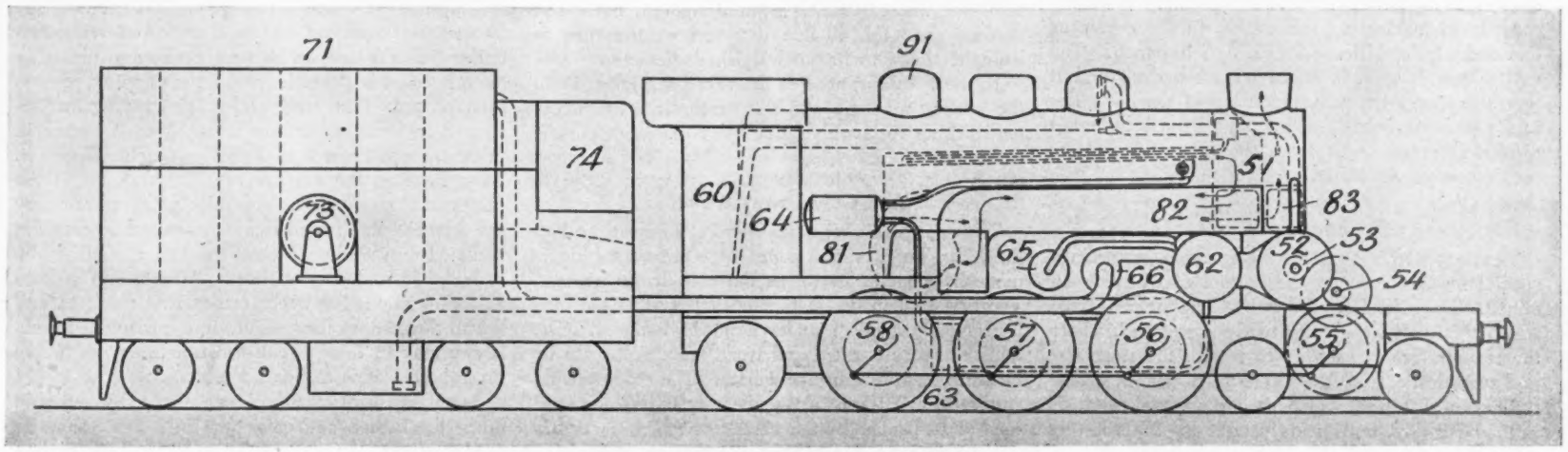
In the Krupp locomotive the boiler, the frame, the driving wheels, and so on, are essentially the same as in the standard locomotive. The steam cylinders are, of course, eliminated and in their place a steam turbine is adjusted at the front end above the leading four-wheel truck. It is placed in two compartments (see diagram), 52 being the forward turbine on the right side of the locomotive, and also the reverse turbine, which is carried on the left side. The speed of revolution of the turbine is from 6,000 to 8,000 per minute, and by means of the gears, 53 and 54, the speed is reduced to the required number of revolutions for the driving wheels 56, 57 and 58, the crankshaft being driven at the required speed of the driving wheels, to which it is connected by means of connecting rods and coupling rods. One advantage of the even torque of the turbine is that it is free from the trouble in starting a reciprocating engine which occurs when the cranks are in an unfavorable position.

Results in Permanent Fuel Economy

From the turbine the exhaust steam is led to the condenser (62), from which the water at a temperature of about 140 degrees, Fahrenheit, is driven by means of a pump (63) through a pre-heater (64) to the boiler. An air pump (65) removes from the condenser any air that is carried there by the water, or may have entered through various leaks. The cooling water for the condenser (62) is supplied by a centrifugal pump (66). It circulates through a tube system and leaves the condenser at a high temperature. As a train, when on a run, cannot carry sufficient water for cooling purposes, it is necessary that the water be cooled again; and this is done on the tender (71) where there is provided a large number of spaces which work on the same principle as the graduations in salt works. Here, however, instead of brushwood, a large cooling area is provided by a series of metal tubes which are cooled by air from the fan (73). The temperature of the water is reduced sufficiently for it to serve again as cooling water, and it is returned to the condenser by means of the above mentioned pump (66). The tender is so constructed that it can carry a sufficient load of coal for the run.

In the reciprocating locomotive sufficient draft for the furnace is provided by the discharge of the exhaust to the smokestack; but in this locomotive the draft is provided by a rotary fan which is shown at 81. The furnace gases are drawn by this fan from the chamber (82) on the right side of the locomotive and are discharged at the left side through the chamber (83) in the smokepipe.

Because of its many auxiliary machines, pumps, fans for draft and cooling water, etc., the first cost of the locomotive is higher than that of the standard reciprocating type; but it is believed that the constant saving of twenty percent of the fuel will not only pay for the higher first cost, but will result in a permanent fuel economy.



OUTLINE DRAWING OF THE LOCOMOTIVE

The numbered parts indicate the many auxiliary elements necessary in a turbine locomotive

The Story of Steel—XII

Manufacture of Seamless Steel Tubing

FROM the early days of steel pipe or tube manufacturing, the makers have realized the advantages which would be secured if they could make tubing without the longitudinal seam which characterizes the lap and butt-welded piping described in our last chapter. The earliest recorded efforts in this direction were made when Hanson took out an English patent for the making of seamless tubes in 1837. Under this method the steel was squeezed through a small orifice around a punch. Then came a modified method patented in England in 1867, and another patented in 1882, the latter by Elliot. Elliot, according to his specification, forced melted steel hydraulically through an annular orifice, with the object of securing a tube in which the fibres were arranged helically. Another early process was that of "cupping," in which a cup was pressed from a flat disk and gradually elongated into a tube by passing it through a series of reducing dies.

Many of our readers will be interested to know that the popularity of bicycle-riding a generation ago gave a great impulse to the manufacture of seamless steel tubes. The tubes were drawn cold from billets which were prepared and partly finished into tubes, in England and Sweden. Finally, the great demand for high-class seamless tubes for naval and marine boilers and for locomotives, led to the development of the methods of making "Shelby" seamless steel tubes, as illustrated and described in the present article.

Forming Blooms Into Billets

What might be called the raw material for the manufacture of seamless steel tubing consists of blooms, varying from 6 to 10 inches in section and about 11 feet long, and weighing from 1,300 to 3,750 pounds. The blooms are picked up one by one by an electrical charging machine and placed in a special heating furnace. Here, when the proper temperature for rolling has been reached, the bloom is taken from the furnace, placed on a small electric buggy, and transferred to the "rolling table" of the bar mill, where in a series of rolls it is changed from a square bloom into a solid round bar, smaller in diameter but of greater length. Some of the bars thus formed are as much as 8 inches in diameter, while others are as small as 3 inches. While they are still at rolling heat, the bars are cut to different weights according to the length and thickness desired in the finished tube, and, while still hot, they are centered. After they have cooled they are sent to the piercing mill. The piercing operation consists in making an indentation in the center of one end of the billet by means of a punch. The cavity thus formed is about one inch deep and it serves to insure the proper starting of the hot billet in the piercing operation, and also insures an equal displacement of metal from the center to the circumference of the billet.

Piercing the Billet

The next step is to place the centered billets in a special heating furnace, the bottom of which is inclined. The billets are fed into the upper end, from which they roll by gravity to the lower end, where the temperature is such as to render the steel soft and semiplastic.

The solid billet, which is almost white-hot, is pushed forward until it is caught by the rotating rolls of the piercing machine which forces it over the piercing point of a mandrel. The mandrel is a piece of hard steel, shaped something like the projectile of a heavy gun, and it is carried at the end of a rod and is thereby held exactly in the correct position between the two heavy rotating rolls, as shown diagrammatically in one of our illustrations. These rolls are inclined slightly away from the point at which the piercing takes place, and this inclination coupled with their rotation in the same clockwise direction, as shown in the accompanying illustration, serves to draw the solid billet forward over the piercing point of the mandrel. The effect of this is to cause the metal of the billet to flow past the mandrel and form the billet into a heavy solid tube. This operation requires enormous force, the degree of which is hardly suspected by anyone who witnesses the operation. The piercing machine is of such power that the solid metal of the billet is transformed into a tube with the same ease with which a lump of dough is manipulated into shape by a pastry cook.

Rolling the Pierced Billet to Size

The pierced billet comes out of this operation as a rather rough thick-walled, seamless tube. Although it is rough as to finish, it is without seam or weld, the round bar of steel having been pierced through its whole length much as a potter would force a pointed rod through a cylindrical mass of moist clay. After its passage through the mill, it is rather short and its walls are of considerable thickness, and the next step is to reduce the thickness and increase the length and so form the desired size of tube. This is done by passing the pierced tube through adjustable half-round rolls between which is a mandrel held in place by a long steel bar just at the point where the thickness of the wall of the tube and its diameter are to be reduced. As it passes through this rolling mill, it is converted into a much longer tube with walls of uniform thickness, and it carries a fairly smooth finish.

The Reeling Machine

The next step is to pass the tube, which is still at a suitable working temperature, through what is known as the reeling machine. This is another form of rolling machine consisting of two heavy rolls of special design set with their axes askew, and these rolls are capable of adjustment to a thousandth of an inch. We show in one of our diagrams the nature of these rolls, their position, and their relation to the mandrel and the tube which passes between them. In this operation any mill-scale is removed; the tubes are given a smooth, burnished surface; and the outside diameter of the tube is brought closer to its final finished diameter.

In the finishing process the tubes are taken from the reeling machine and passed through the sizing or finishing rolls which give them the exact outside diameter.

The Cold-Drawn Process

The processes above described are known as hot-finishing, but a vast amount of seamless tubing is made by what is known as the cold-drawn process. The first step in this is to point the end of the tube by swaging it down under a power hammer. The tubes are then cleaned and freed from mill-scale by pickling them in a hot acid bath. The cold-drawing apparatus consists of a very heavily built horizontal steel draw-bench, in the center of which is firmly positioned a hard die through which the tube is to be drawn down. In front of the die there is a heavy endless chain which runs over a wheel located underneath the die, and which travels along the top of the draw bench and in a direction away from the die, for a distance of 15 to 40 feet, and then passes over a sprocket which is power-driven. The chain is endless and returns underneath the draw bench.

The hot-rolled tube, which is now perfectly cold, is inserted in the die with its pointed end projecting toward the endless chain. A mandrel is then slipped into the tube from its rear end until it lies in the proper position within the die. Then an operator seizes the pointed projecting end of the tube by very massive tongs, which are hooked to the endless traveling chain above described, and by this means the tube is drawn or squeezed through the die—that is to say, between the die and the mandrel which has been previously inserted. All tubes except those of half-inch inside diameter and less, and those tubes in which the wall is very heavy relatively to the diameter, are drawn over mandrels in this way. The dies, which, of course, are subjected to very heavy service, are made of the best grade of crucible steel and are machined down to the thousandth of an inch so as to accurately govern the outside diameter of the tube. The tubes are drawn from two to twenty times through dies of varying diameter and are thus brought down gradually to the required dimensions.

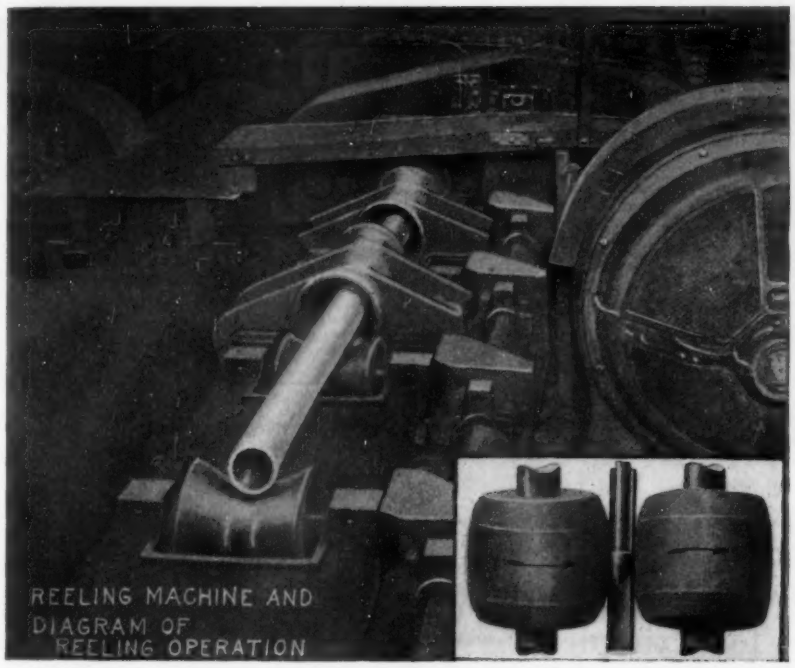
Annealing and Testing

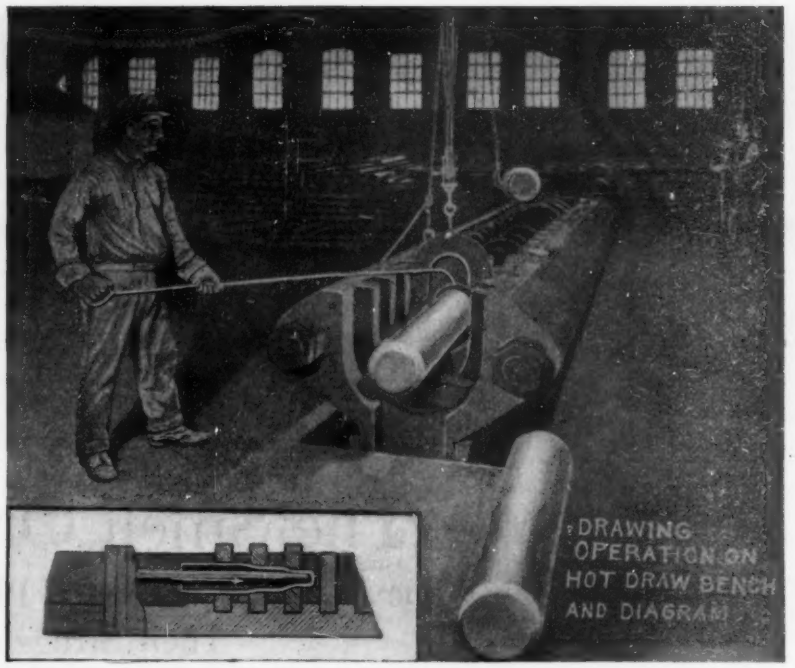
After this cold-drawing the tubes are annealed to take out the working stresses. Cold-drawing makes the tube hard and brittle and, hence, after each draw-pass the tube has to be annealed in order to make it soft enough to withstand the next drawing. Annealing forms scale on the tube, and this is removed by pickling. That annealing is a very important step may be judged from the fact that it varies from a "light" annealing to remove initial stresses to a "long" annealing in a closed box to render the tubes very soft and ductile. Cold-drawn tubes are then passed through the straightening machine and from them to the cutting-off machine, where they are cut to the desired length. The "Shelby" seamless steel boiler tube is subjected to a hydrostatic pressure which varies from 1,000 pounds per square inch in tubes under 5 inches diameter, to 800 pounds per square inch in tubes over 5 inches.

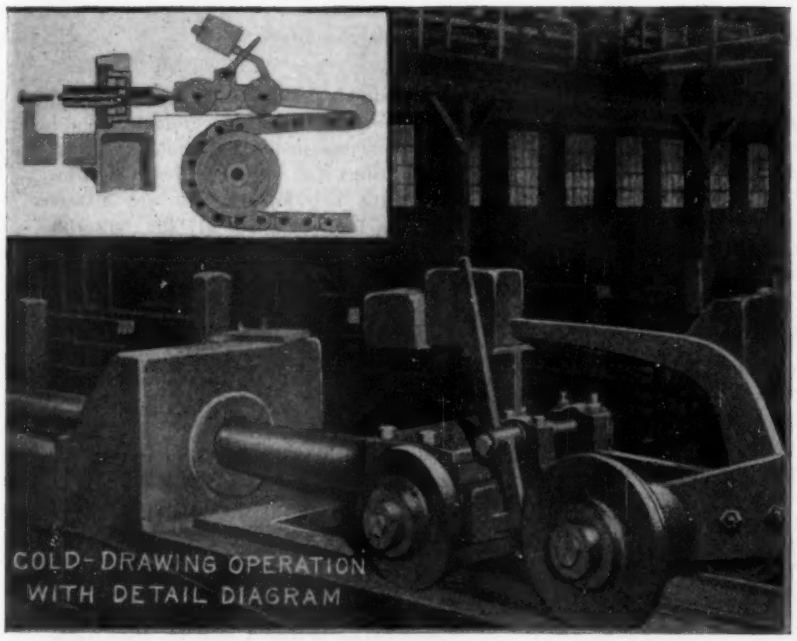
The Cupping Process

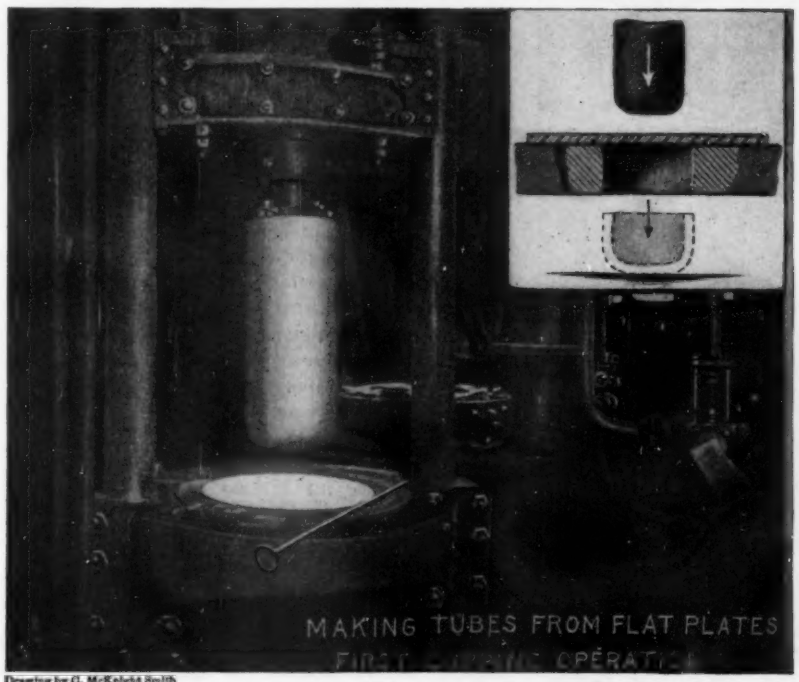
Finally, there is a method of making seamless steel tubing from flat plates or by what is known as the cupping process. When a seamless tube of, say 20 inches is required, the rolling and piercing machinery would have to be so gigantic and unwieldy as to become impossible, hence the cupping process is employed. The steel plates for cupping are delivered in squares varying from $\frac{3}{8}$ to 4 inches in thickness and from 2 to 7 feet in outside diameter. After heating, the corners are sheered off and the plates are passed to a hydraulic press where they are punched into rough shallow cups. The cups are reheated and again punched through a smaller die to lengthen and deepen them. After a cup of suitable dimensions has been formed it is reheated and drawn through a series of dies in a horizontal bench. A cup may be heated and drawn as many as twelve times before it is a finished tube.

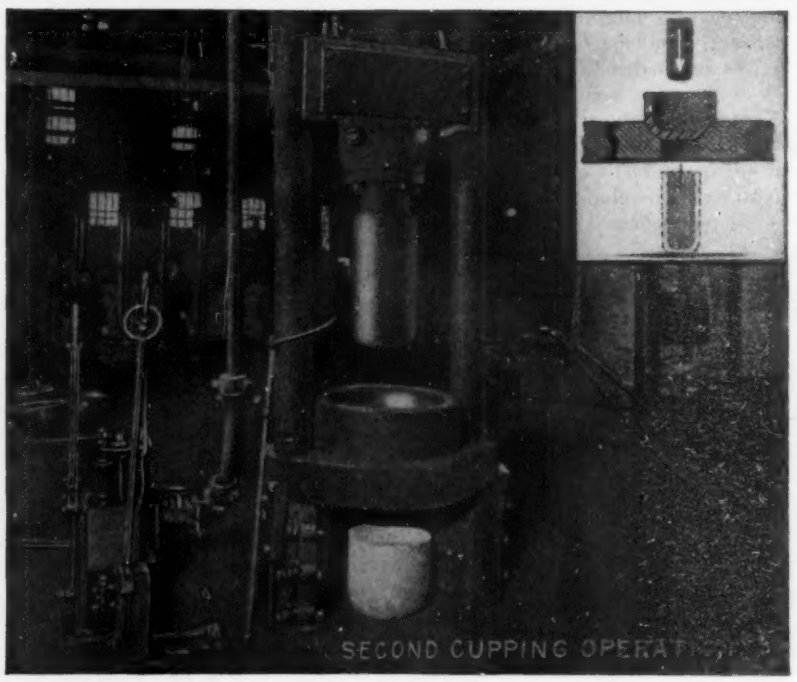
Seamless steel cylinders are made by swaging down the heated end of a tube in a lathe running at high speed. A steel tool is brought to bear against the heated end and closes it up into a spherical form.





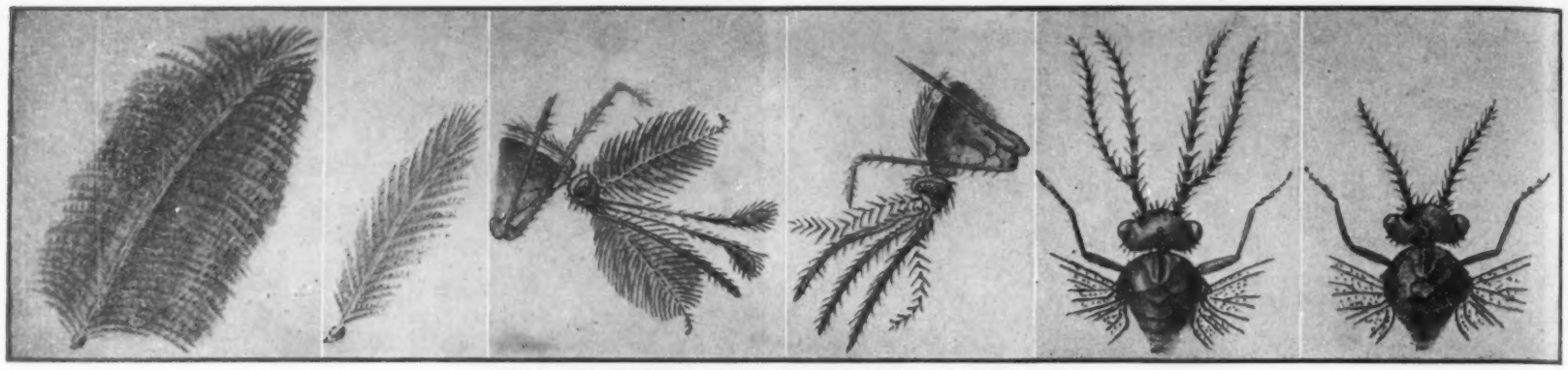






Drawing by G. McKnight Smith

Various Steps in the Manufacture of Seamless Steel Tubing



CONTRASTS BETWEEN MALE AND FEMALE ORGANS OF SMELL

From left to right: the feathered antennae of a male tropical Bombycid moth; those of the female moth; the plume-like antennae of a male malarial mosquito, showing also the lengthened spatulate palpi and the proboscis; the same organs of the female mosquito; the forked antennae of a male sawfly; the simple antennae of the female of this same species

The Smell Organs of Insects

The Antennae of Insects Play a Most Important Part in Their Struggles for Existence

By S. F. Aaron
Lincoln University, Pennsylvania

THE extreme development of the olfactory organs of many creatures, both with and without backbones (vertebrates and invertebrates), plays an important part in their struggles for existence. However delicately the sense of smell has been developed among the quadrupeds, especially the dogs and the weasel group, it is far inferior to that of many insects, as may be readily observed. This is an essential compensation for having, generally, no hearing and with eyes capable only of seeing at short distances and then without discrimination. Insects need a sense that will detect both friends and enemies and guide them long distances and unerringly to food.

The organs of smell in the Arthropods (which group includes the invertebrate animals having locomotory appendages), are the antennæ. This fact has been questioned and controversy has arisen over it, but it is now generally admitted, for experiments clearly indicate that with these often peculiar and highly developed head appendages removed there is no apparent reception of odors no matter how peculiarly enticing. The antennæ are used also as feelers and perhaps for detecting disturbances in the air as caused by a slowly approaching enemy. Considering the nature of its transmission the power of smell as possessed by insects rivals the acute sense of hearing in many quadrupeds and the sight of the most highly developed eyes, far surpassing the eyes of all invertebrates.

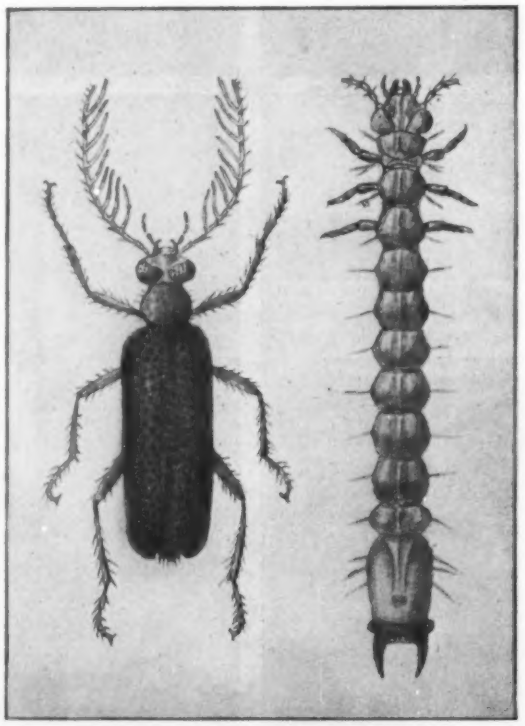
Males and Females Meet by Smell

The most extreme example that has been observed concerns the emergence of a female moth from a wild cocoon taken to the heart of a great city and the visitation within a few hours at night of many males that had come from suburban sections more than three miles away; this on a still night and the visitors drifting in from many directions.

Close observation out of doors will determine that insect antennæ are put to most important uses; not only the saving of life, but also its prolongation and its propagation. The honey and flesh-loving Diptera, the butterflies and certain Hymenoptera are the best examples for study. Watch a bee-fly alight among plants not yet in flower and with a sudden shift of the breeze see him discern a honeyed blossom a few feet away. The insect slowly faces about toward the desired object, turns a little too far, then back again, its pendant antennæ with the central erect bristles slowly moving back and forth, then it suddenly makes a beeline for the delectable object. Blow and meat flies alighting upon a covered bundle of the butcher's product crawl about to find the hoped-for opening and clearly follow the lead of the extended and waving smellers.

Aware of Danger by Scent Alone

When the digger and mud-dauber wasps are seeking their prey the use of the antennæ in making discoveries of spiders, caterpillars or grasshoppers may be observed plainly. A huntress is resting idly for a time and a spider passes quite near and behind her. She instantly shows a certain restlessness. The curved antennæ are bent backward over the high thorax and slowly waved back and forth, as always when an odor is detected. Suddenly she wheels about in obedience to her paramount instinct, grabs the spider, stings it at leisure and carries it away.



TWO STAGES OF THE SAME BEETLE

The male under-bark beetle (left) and its larva, showing the antennal development of each

Those adult Lepidoptera that are attracted by sweets, as is the case with all the butterflies and most of the moths, show the value of their antennæ as guides to delectable odors. The nearer they come to a definite scent the more the antennæ flutter and shift until finally they point in the desired direction.

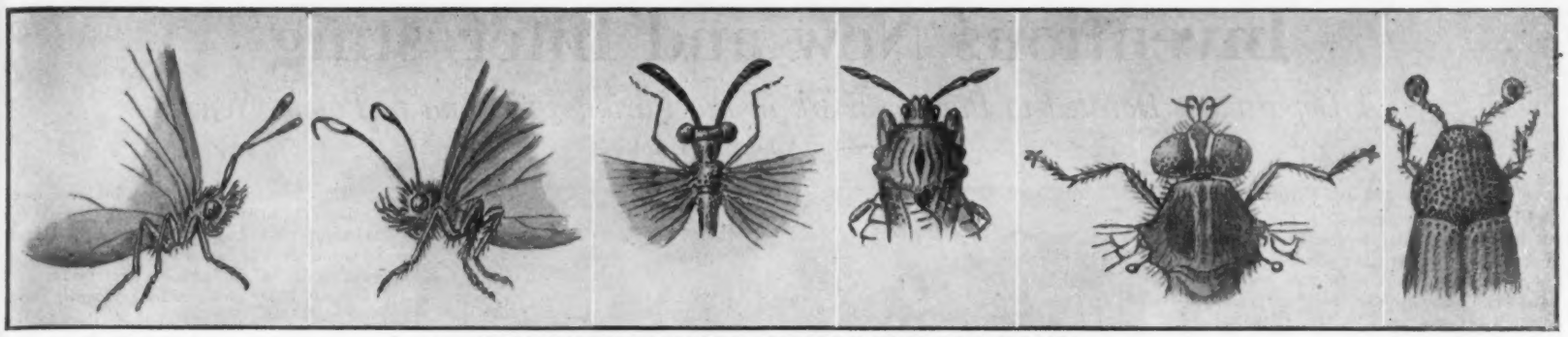
Approach with most deliberate motion an alert butterfly perched with ready wings awaiting a playful invitation from one of its sportive fellows. The creature cannot hear you and its lack of intelligence does not permit it to recognize your form by sight as a possible enemy. It may select your hat or shoulder or leg as its next perching place. Nevertheless it becomes aware of your presence as something unusual and possibly menacing and this by scent alone.

Feminine Wiles Aided by Perfume

Fully as important as the detection of food, or the discovery by this means of an enemy, is the sense of smell to most insects as a guide to propagation. Courtship with most species is not a matter of attractiveness to the eye, but is one of agreeable odors. Has the female of the genus Homo with her use of various perfumes retained this tendency through a long-time inheritance from an ancestral type that likewise branched off to the insect?

As an argument for the antennæ: many male insects that court females that do not seek the males possess antennæ far more complicated and much larger than the antennæ that seem to be needed by the egg-laying sex. Witness the feather-shaped smellers of certain moths and those of the male mosquitoes and allied gnats, the extended and thicker antennæ of male scale insects and the forked or single-branched horns of male saw-flies and certain beetles. Where the females do as much of the seeking and the courting as do the males, or where they do all the seeking, as, for example, the female long-horned grasshoppers (katydids, true and false), the antennæ are alike in the sexes and, moreover, there are other uses which may govern this.

Most interesting and convincing are actual experiments. The removal of the antennæ close to the head by a sharp pair of scissors does not seem to



THE THICKENED BULB-LIKE ANTENNAE OF SEVERAL INSECTS

From left to right: The knobbed organs of a yellow clover butterfly; those of a skipper (Hesperid) having the hooked knobs which are characteristic of this family of butterflies; the club-like antennae of an ant-lion fly; those of an ambush bug; the lobed organs of smell of a Syrphus fly, each with its intermediate bristle; the broadly knobbed antennae of a bark engraver beetle

annoy the insect to any considerable degree after a time; the organs are not at all vital, nor is the nervous construction such as to cause the creature actual pain. However thickened the basal joints may be, which is common, the attachment is generally slender. It is possible, indeed probable, that the palpi, especially when large, are also used for smelling. They are primarily feelers at close quarters used for sampling food or recognizing friends and thus they must be receptive of odors. In spiders, which have no antennæ, the well developed palpi are probably the only organs of smell. But these most intelligent little creatures do not possess a fine sense of detecting odors, for one will climb its silken thread to the human hand that suspends it and not until the hand is reached will the spider become alarmed and drop.

An Experiment With Blowflies

The antennæ are generally made up of many joints, the terminal ones often larger, giving a knobbed or clubbed appearance, as in the butterflies, many beetles, most bees and wasps, water and nerve-winged flies and certain bugs. They are often many-branched, or they possess extraordinary length, as observed in the crickets, long-horned grasshoppers, the Lamelicorn beetles and, most remarkably, in the caddis-flies.

The writer caught in his insect net thirty-one blow-flies attracted to a piece of tainted meat. Sixteen of these were deprived of their antennæ and all were turned loose in a large room. The meat was placed on a table top. They flew about mostly in an effort to escape through the screened windows, but eventually the continued urge to deposit their eggs made them seek the common medium. Thirteen of these flies soon found the meat, but all of these thirteen possessed antennæ and only one of those without these organs found it eventually although quite by accident. Five of the flies without antennæ were put under a screened cover and coming into contact with bits of meat greedily sipped the juices and laid their eggs thereon. The entire number were shortly caught again and killed.

No Antennae—No Love

Eight freshly emerged females of the common yellow sulfur butterfly and five males were liberated in a screened room where a bunch of red clover was placed on the floor in the center of the room. The antennæ of four of the females and three of the males were clipped off close to the head. Within less than an hour all the four females whose smellers were intact had been unable to withstand the near odor of the natural food plant of their larvæ and had laid eggs on the clover. The other four had not found it, although when the plants were placed in the window sill and, in their flopping about these specimens without antennæ happened to alight on it, all four promptly laid their eggs also. The two males with antennæ promptly responded to the lover-like tendency and began paying court to some of the females, while those with their antennæ missing could not even be lured by sight until an enchantress happened to come near.

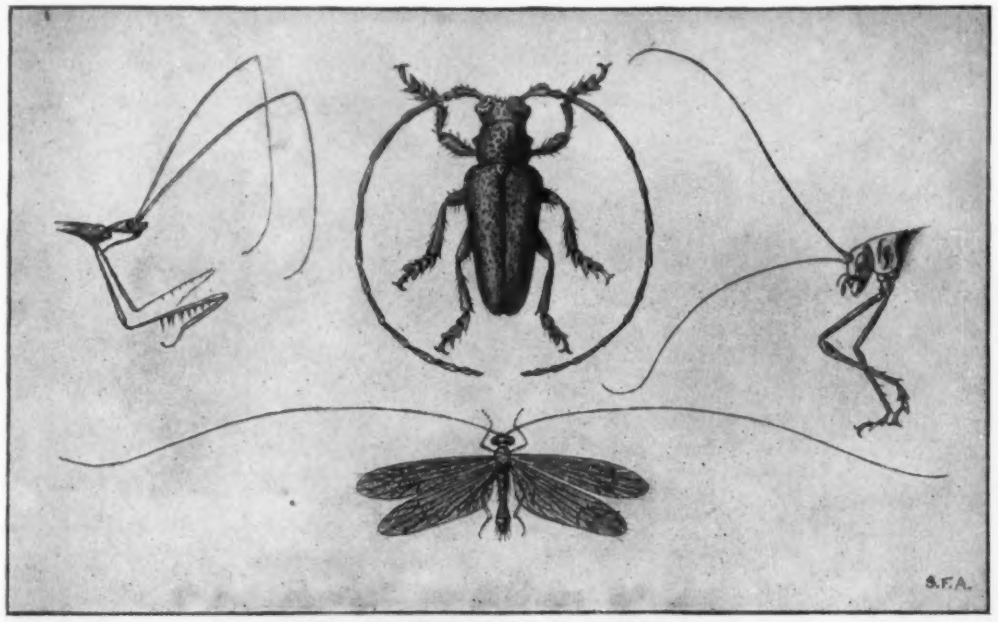
Many years ago Mayer took several hundred cocoons of the moth Promethea to the Florida Keys. Here where no other of the same species existed, female moths were confined in transparent jars by means of netting. As a check on this group, other females were placed under inverted glass jars whose lower ends were buried in the sand.

Male moths of the same species were then released at various distances. They were soon able to find their way to the jars whose moths were obstructed only by netting; but they did not succed in locating those with hermetically sealed openings. Nevertheless, the female moths had all the time remained clearly visible through both kinds of jars.

Further to demonstrate how fully these insects depend on their acute sense of smell, a thin coating of shellac was placed on the antennae of several male moths. Even though they were brought almost within touch of the females they now paid no attention to them. But blinded moths having undamaged antennae experienced no difficulty in finding the females.

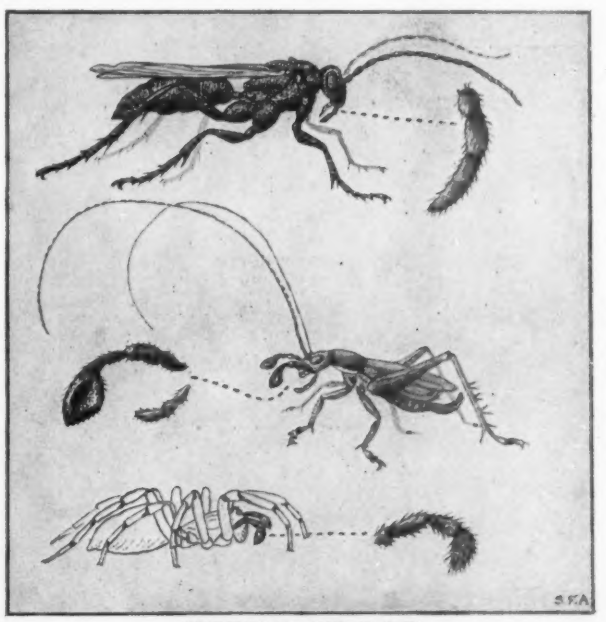
Wasp Could Not Find Prey

I caught a mud-dauber wasp that had half completed her nest and I clipped off the antennæ. After sulking awhile and rubbing her face with her fore-legs she went on with her building until the cell was completed. Then she commenced to hunt for spiders wherewith to store the cell, but the wasp must have been entirely unable to find any game without the power to smell it out, for in about twenty minutes she returned to the nest, wandered about it, went away again, was back in about half an hour and still without a victim. Unwilling longer to witness her disappointment I caught and put her in a cyanide bottle.



LONG AND SLENDER INSECT SMELLERS

From left to right: the hair-like antennae of a silt-bug; the so-called horns of a longicorn beetle and the thread-like feelers of a long-horned grasshopper. Below are the excessively long antennae of a caddis fly



ANTENNAE AND PALPI

Above is a digger wasp and its palpus. Below this is a cricket and its palpus. At the bottom is the palpus of a spider.

Inventions New and Interesting

A Department Devoted to Pioneer Work in the Various Arts and to Patent News

Conducted by Albert A. Hopkins

The Aristocrat of Potatoes

JULIENNE potatoes took a long time in becoming popular, largely for the reason that our knives were not adapted to make the delicate shavings or whatever we may call them. The two knives illustrated hail from France and are both very efficient, but even with these a little practice is necessary before the potatoes are properly cut and ready for the hot fat.

Julienne potato knives

Electricity in the Beauty Parlor

THERE are many uses in the beauty parlor for the device illustrated here. With it the neck may be shaved; the scalp or face massaged; hair combed, or the teeth brushed. We have on a number of occasions shown electric shaving devices, but not, we believe, any with the plurality of uses to which this instrument may be put. Of course, it is also valuable for men's use, and will take an "old line" razor, or any safety razor blade.

This youngster (weather permitting) cannot only read the time on the sun dial calculated for Baltimore, but for other cities as well. It is in Druid Hill Park, Baltimore, Md.

The American ice cream business owes a big debt to Dolly Madison. She made ice cream popular and fashionable in the United States. It was introduced into the United States by a Philadelphia caterer named Bosia in 1800, but never became really popular until Mrs. Madison was mistress of the White House. It was not until 1851 that the first wholesale ice cream business was started by Jacob Russell in Baltimore.

Vegetable scoop for making ornamental shapes

Vegetable Scoops for Making Decorations

EVEN the lowly beef stew can be made beautiful with the aid of vegetable scoops, which come in all sizes and patterns. They will cut a carrot, a beet, or potatoes into small pleasing shapes and when used with Parisian potatoes a very attractive variety is obtained. The French are particularly fond of using such kitchen implements and the results are well worth while.

Ice Cream Industry a Large One

WHILE it is rather generally accepted that ice cream was first made in Italy, where "gelati" and "granita" still charm tourists, it remained for the United States to develop the industry on a vast scale, Prof. Martin Mortensen, head of the department of dairying in the Iowa State College, said recently before the World's Dairy Congress.

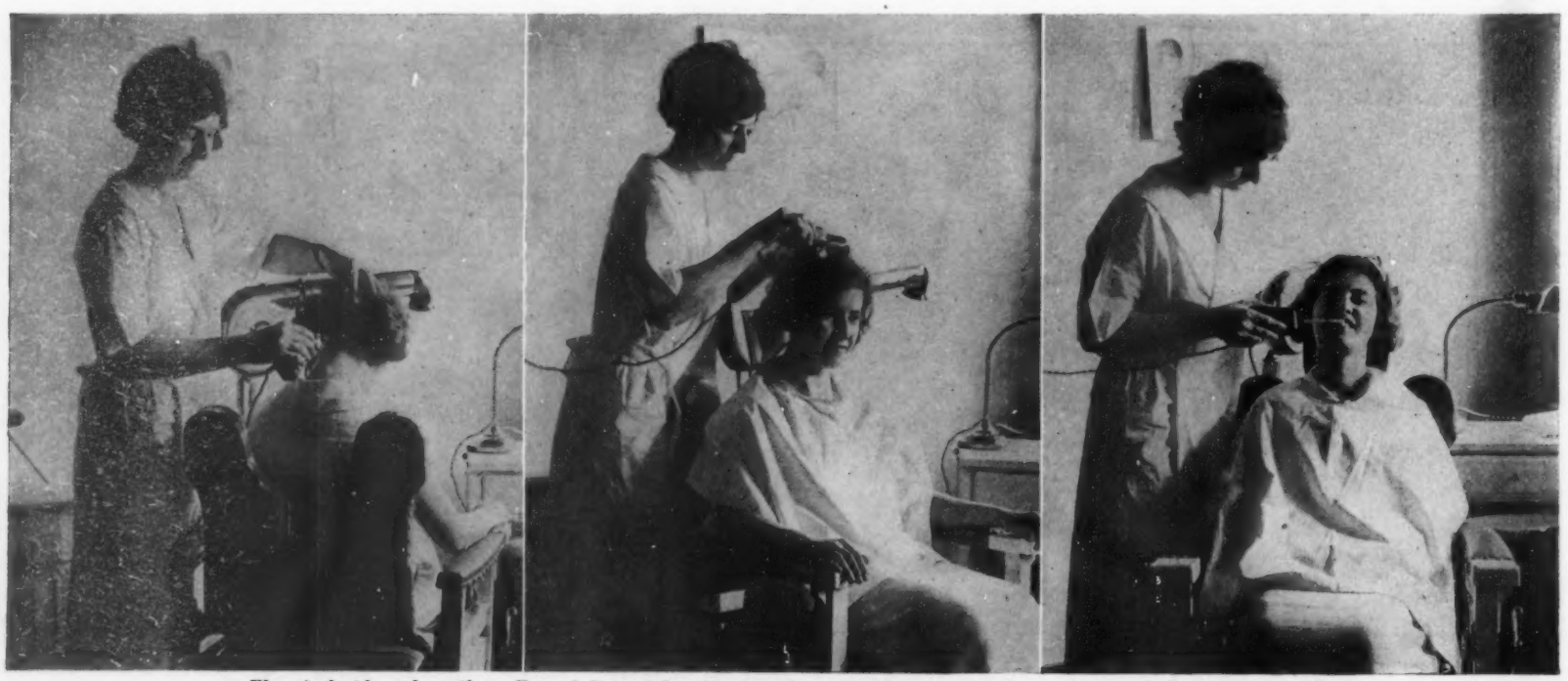
It is thought that ice cream was introduced into France about 1550 and the earliest printed record of it in England was found in a housekeeping magazine published in 1786.

The ice cream business in the United States increased from 80,000,000 gallons in 1909 to 263,529,000 gallons in 1912. The ice cream cone, invented in 1904, was a great factor in making ice cream popular.

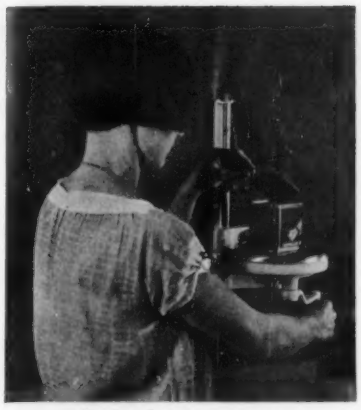
Prof. Mortensen attributed the great success of the industry to the sound business principles employed by the men who entered it. He said the rapid development of machinery, trade journals and instruction in colleges in the art of ice cream making had done much to increase the business.

Artificial Method Supplants Sun for Prune Drying

CALIFORNIA sunshine, famous though it be, has been "covered by shade" in the prune industry. Experts from the University of California announce that dehydration, or artificial drying, is superior to having the sun dry the prunes. They predict that eventually all prunes will be dehydrated.



Electrical aid to the toilet. From left to right: Shaving the neck, electric comb for waving, and cleaning the teeth



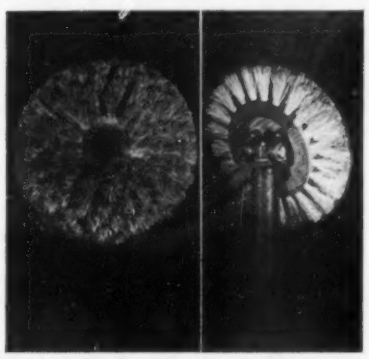
Again the can opener

A Can Opener That Opens

THE can opener, illustrated above, automatically grips cans of varying sizes and shapes with no other adjustment than the turning of a crank. Another feature is the automatic lifting of the cover so that the person operating can receive the cover as cut out without in any way contaminating the food by the cover dropping down into the food.

Carbon Removing Brush

HERE is the brush that really gets the carbon—all of it, quickly. It makes carbon removing a much easier, more profitable job. The hardest, toughest deposit of carbon quickly yields to the stiff, sharp



Brushes for keeping the bathtub clean

points of the steel brush illustrated. It peels off the carbon right down to the metal, leaving the cylinder heads and blocks brightly polished. No single wire comes straight down from the top. They overlap and support each other, half an inch above the bottom. It enables you to use the brush either tilted or vertical so that you can get into corners and do a thorough job.

Ordinary cleated tractor wheel tends to injure the road

A brush that makes carbon removing a simple task

Used with small electric drills or with a flexible shaft—fitted with both one-quarter and seven-sixteenth inch arbors.

An Aid to Bathtub Cleaning

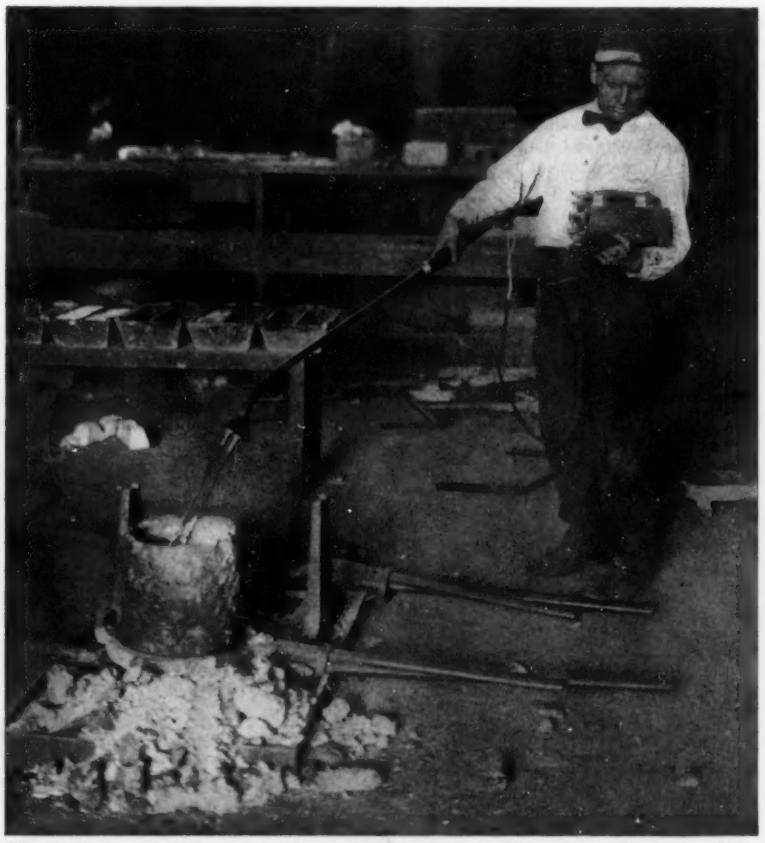
THE device illustrated is designed to make bathtub cleaning easier. Heretofore, it has been looked upon as hard work and, when done with a wash cloth, sponge, or short-handled brush, it was, of the hardest kind. This applies particularly to apartment bathtubs which are so situated and surrounded that it is almost impossible to clean them in the old way.

Makes Tight Neckbands Loose

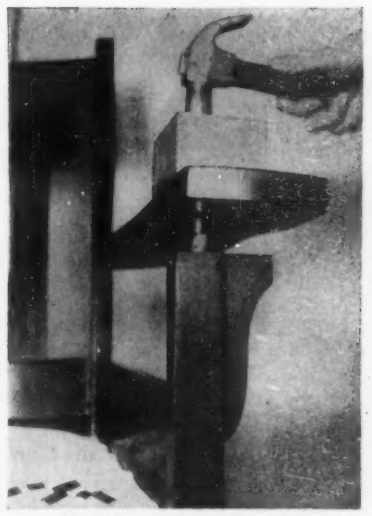
AN extension collar button, which extends the neckband, and is said to remove pressure, and give proper adjustment to shirt and collar is illustrated here. Shirt neckbands shrink from repeated laundering and sometimes cause much discomfort. Here is the answer to the riddle.

Mends Chairs Without Glue

AN easy way to cure sickly furniture. The small metal piece has several protruding points, and when driven in as shown



The molten metal thermocouple inserted in the crucible gives a direct reading of temperature



Useful metal repair parts

in the illustration on this page the point will hold it securely. Any force tending to remove the arm from its original position will increase the grip of the metal part.

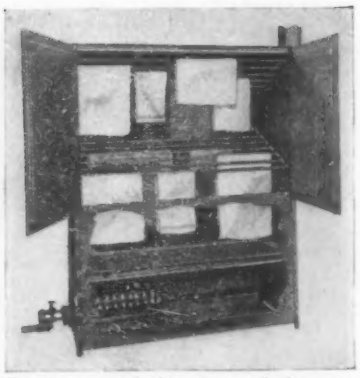
These small metal repair parts are also used to repair handles on mops, mallets, brushes, and so on.

A collar button which extends the neckband

Portable Molten Metal Pyrometer for Non-ferrous Application

IN the successful casting of brass, bronze, aluminum and allied compositions, proper pouring temperature is of primary importance. Pouring of the metals into the mould must take place when the same is of the proper consistency or fluid enough to fill all sections of the mould. The molten metal thermocouple when inserted in the crucible reads almost instantaneously, because the thermocouple elements or tips are not covered with heavy protection tubes which would seriously affect results obtained through a lag in the indications of the temperature device.

This type of tractor wheel will protect the road



By the use of this dryer clothes are dried quickly and thoroughly

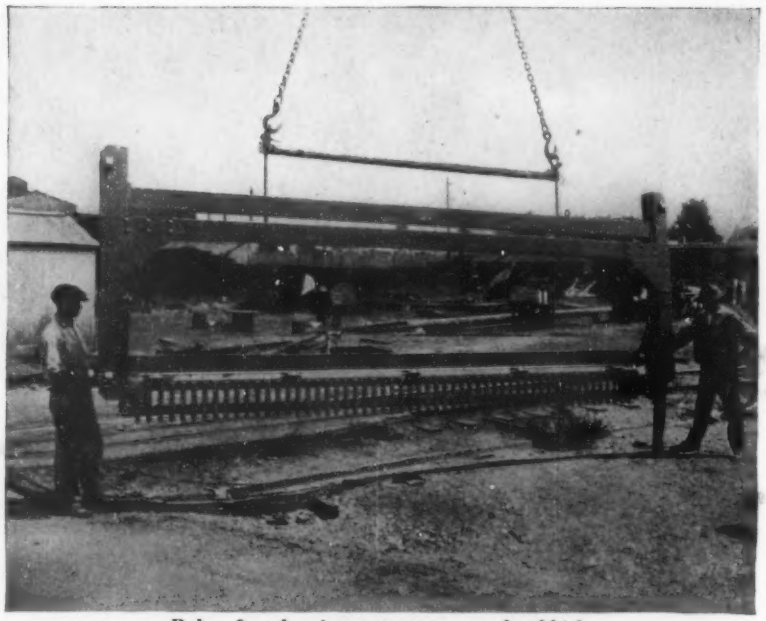
Drying of Clothes Made Easy

THE discomforts and dangers of hanging out clothes to dry are eliminated by the drying machine illustrated above. The price of this apparatus is low enough to bring it within the financial reach of the average home-owner. The clothes are dried in this cabinet by ventilation; the air entering at the bottom, being heated by gas (or electric) burners, rushing through the holes in a deflector plate, and through and around the clothes, absorbing the moisture and passing out at the top through a vent. It is claimed that by means of this dryer one batch of clothes is dried by the time another batch comes from the washing machine ready to be hung up.

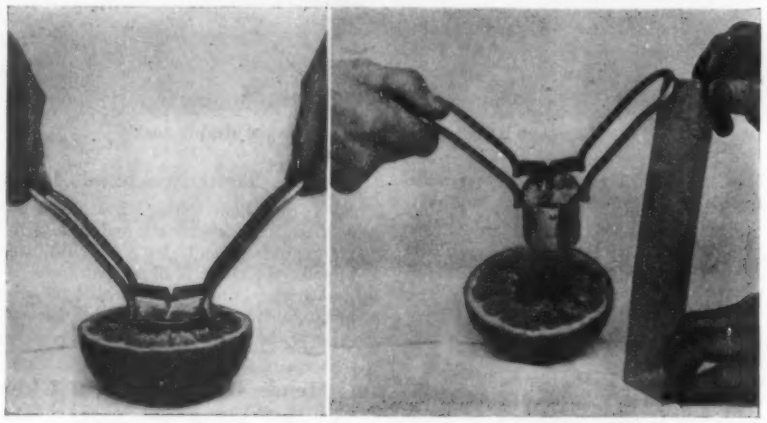
A Rack Rake for Taking Care of Debris

DRIFTWOOD, logs, bark, and so on, that come down with the spring floods are apt to clog the racks or screens through which the water passes before going to flumes, intakes and so on. The device shown is a power-operated mechanism that will completely clean rack rakes of leaves, grass, sticks, bark, stones and so on. In case logs or trees are encountered, log hooks can be attached to the rack rake.

The rake proper consists of substantial wrought steel fingers pointed at one end, so as to project into the spaces between the rack bars. The fingers rest on two heavy steel angles and are riveted thereto. The frame, with rake attached, travels up and down the surface of the rack and is supported by rollers which travel preferably in steel guides, but which, in special cases, can be arranged to travel on the rack bars without guides. With the teeth in a horizontal position and projecting slightly into the rack bar spaces, the rake is then hoisted to the top of the rack, cleaning all trash from the rack as it moves upward.



Rakes for cleaning water screens of rubbish



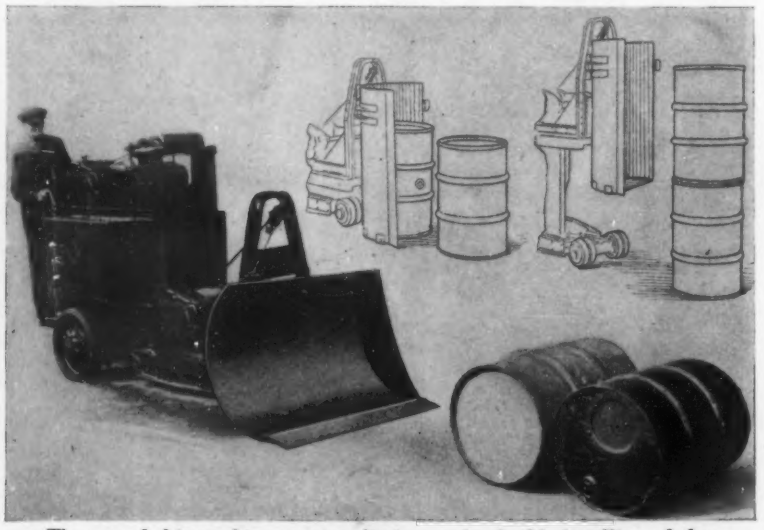
Pressing the handles of this corer tightly together does the work of removing the seed core quickly and neatly

Electric Elevator Stacking Tructor

THE tructor illustrated on this page handles rolls of fabric, carpet, linoleum, rubber stock, steel, newsprint, and barrels, bales, boxes, textile beams, and so on. Its method of handling is very ingenious, automatically picking up its load in any position and stacking either vertical or horizontal, as desired. The elevator raises the lower end of the load up to an elevated position of six feet. Thus, material six feet high can be stacked, end to end, to 12 feet heights with practically no additional attention. This method saves much valuable storage space, eliminates the double handling by the cumbersome block and tackle method, results in the conservation of time and labor, and avoids the usual hazards attendant on hand handling.

The unit consists of an elevator tructor with a revolving apron or cradle for securing the load at the end of the platform, the cradle being built to suit.

The pressure toggle attachment ready for application to a punch or other power press



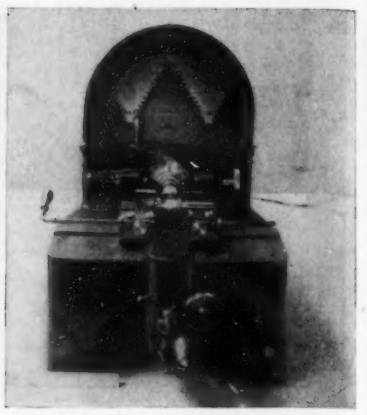
The use of this stacking tractor eliminates the double handling of the cumbersome block and tackle method

A Useful and Efficient Grapefruit Corer

AN aid to quick breakfast getting is this new grapefruit corer. The tubular arrangement is first inserted into the center of the fruit by spreading the handles as shown in the illustration. Pressing the handles tightly together sends the knives down to do their work.

This is done quickly and neatly without the loss of any of the precious fruit juice.

This is an excellent device to add to one's supply of kitchen utensils.



A machine for simultaneously comparing pitch, diameter, form and lead of screws or taps with a master

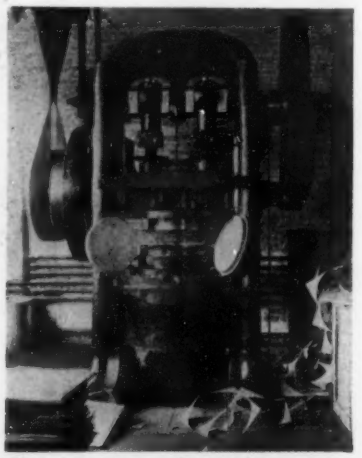
A Bench Screw-thread Comparator

THE scheme embodied in this machine makes it possible to simultaneously compare pitch diameter, form and lead of screws or taps with a master, and to show the extent to which any of these elements vary from the master. It shows by large magnification how the screw will fit in the nut or tapped hole. Rapidly compares all elements of production screw-threads with a master screw which is known to be absolutely correct.

The equipment for inspecting screws consists of cradles in which screws are held for inspection, master gages in which the work is compared and tolerance charts on which the shadows of the threads are projected for comparison. The fixed, threaded cradle is spaced longitudinally from the center of the lens to a distance equal to the length of engagement of the screws being inspected. The second threaded cradle is free to move endwise to compensate for lead errors. The practical advantages are: the fastest method of testing threads; the only method which compares the thread tested with all elements of an accurate master gage and the only method which eliminates the cost and uncertainty of gage wear.

Pressure Toggle for Punch Presses

THE pressure toggle attachment on a punch press provides an equal pressure for the entire stroke, or it may be adjusted so that the pressure diminishes toward the end of the stroke. The advantages of this are self-evident to practical men who know by experience that the wrinkles form in the beginning of the stroke and that the full and maximum pressure is required then, while the breakage occurs at the end of the stroke and is mostly caused by the draw ring holding back too hard on the metal.



This pressure toggle attachment on a punch press provides an equal pressure for an entire stroke

A useful kitchen tool

A Triangular Rubber Sink Scraper

A RUBBER scraper, or a tin shovel with a rubber edging, is not new, and this scraper may not be, but it is very efficient and can be obtained at any of the large five and ten cent stores for ten cents. We have tested this article and found it useful.

Sealing without the use of heat

The Family Pet's Own Table

THE better dog shops carry a contrivance that tends to create good manners in a dog. This is a little folding table with a small enameled basin. If everybody had the same trouble our photographer had in getting the dog to shine up to the table, we should not call it a great success; but we print it as showing what some dogs may aspire to, in order to raise their standard of living.

Doggie is apparently more interested in the camera than in the feeding table

Washing the Car in An Automobile Laundry

A CHICAGO man has invested $200,000 in a laundry, not an ordinary laundry, but one for motor cars. Our first illustration shows the "shower" with the car on an endless belt. The woman is mopping the top.

The second illustration shows the massed attack of women cleaners rubbing the car with chamois skins and cleaning the glass.

Cold Sealing Wax

COLD sealing wax, that comes in tubes and can be applied without the use of heat is now being marketed. By pressing the tube, after removing the cap, a small amount of wax issues and can be applied on the place to be sealed. The sealing is done with the usual type of sealer. Use of this cold sealing wax eliminates the necessity and annoyance of using fire to heat the old type, saves wax, and is said to make a neater impression.

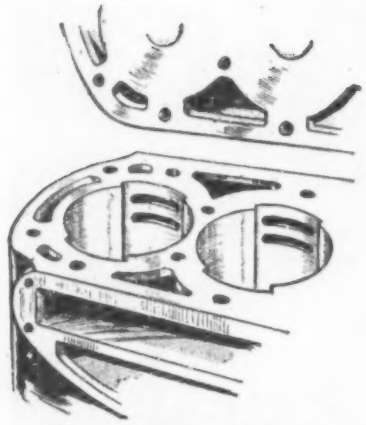
Takes the ache out of mopping

Stooping Unnecessary

MONDAY and Tuesday have washing and ironing, Wednesday and Thursday have sweeping and dusting, and along comes Friday with mopping and scrubbing. It is an unpleasant job at best, and is backbreaking always, unless you have one of the modern scrubbing devices by which the mop is wrung out without bending over. The foot treadle brings the rollers together and squeezes out the water.

This tool opens paper cartons quickly and in a manner that makes it possible to use the carton again

In this automobile laundry a conveyor carries the car through the tubbing operation. The job is finished in fourteen minutes



The exhaust ports are placed in vertical recesses

Belgian Chassis with Slide Valve Engine

THE engine of the Imperia car is altogether unconventional, the cylinder having on each side a long, sliding valve operating in a dove-tail groove and opening or closing points in the cylinder according to whether the valves are raised or lowered by one or two cams in the camshaft set apart for each valve, says *The Autocar* (London). One valve is for the inlet, the other for the exhaust, and both are controlled from their camshafts by rocking levers which exaggerate the cam contour.

Each valve is operated by two cams, one raising, the other lowering the valve. Two inlet ports are used in order to cause turbulence in the incoming gas mixture.

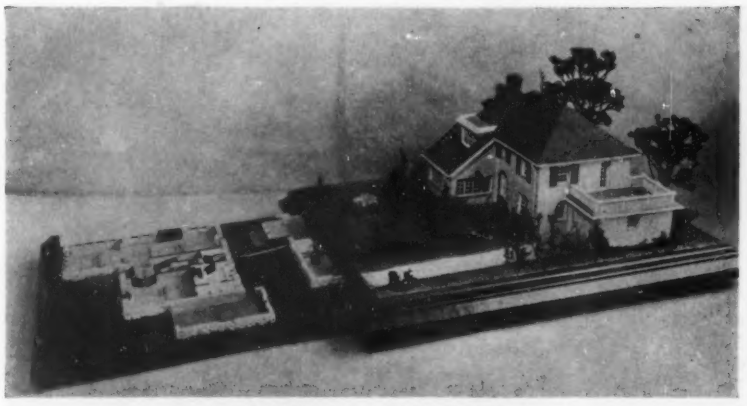
Noiseless Piano Scales

INSTEAD of making days and nights hideous by the incessant pounding of the piano by youthful musical students we can now enjoy immunity from such sounds. The practicing pupils shown in our illustration have before them charts in exact facsimile of four octaves of the piano keyboard.

Helping You to Choose Your House

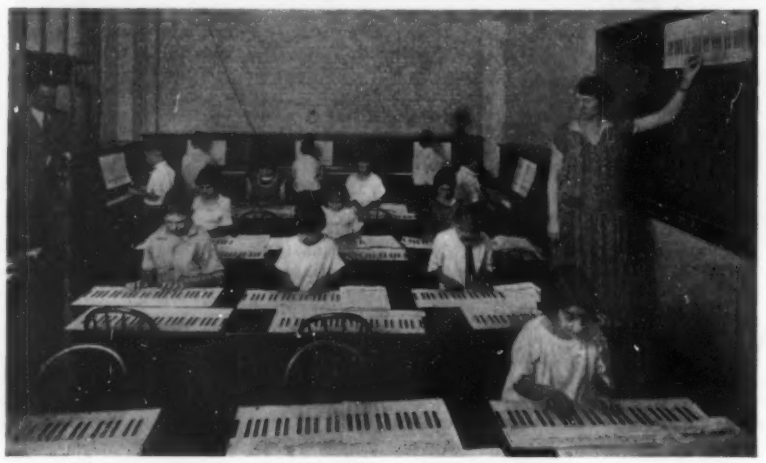
WHEN you try to visualize a house from the architect's blueprints do you find it hard to get an adequate idea of the true relations in size and space of its component parts and fixtures? Two men of Stapleton, N. Y., are the inventors of a simple house model that makes you *feel* that you are actually in its rooms—not on them, as is the case with a blueprint.

In the base of the model is a drawer or till having the floor plan of both stories. These are not merely drawn on it, but are built up about one inch above the floors. It is as if your prospective house had been shaved through horizontally by a great knife about two or three feet above the floors. Miniature replicas of bathtubs, sinks, stoves, and all the things a buyer wants to visualize are shown in these models. The real estate dealer who plans to build a number of somewhat identical houses would find such a model a boon in demonstrating them in advance to prospective renters.

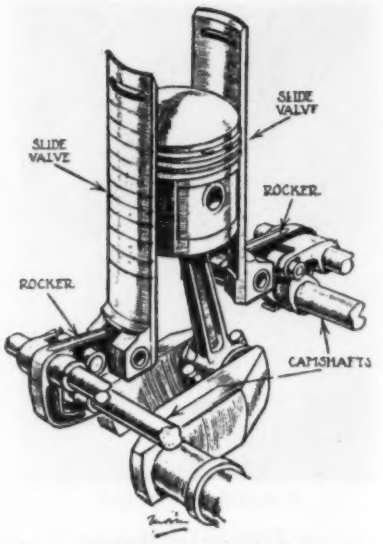


A novel idea for models of houses

At the left, setting the bell punch. At the right, counting the punchings of colored tickets



Noiseless scales for little folks



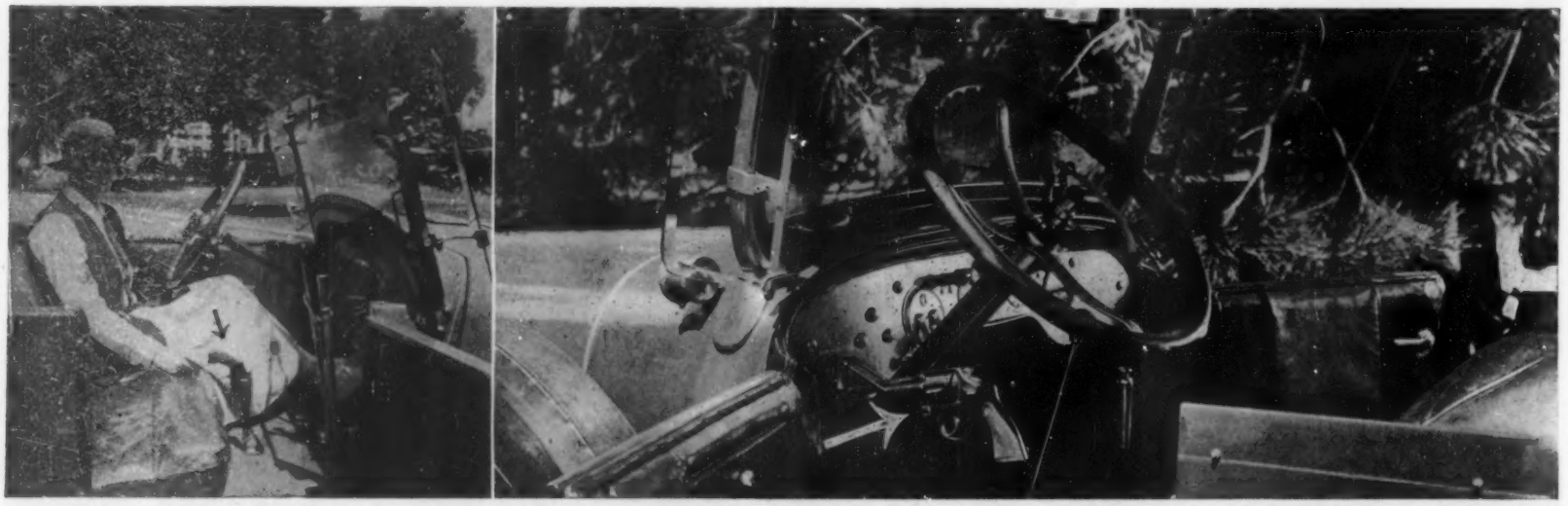
Unique slidevalves resembling tub staves

Girls Who Count "Confetti"

OUT of the many intricate jobs done by women in the new ticket office just opened by the London General Omnibus Company Ltd., at Chiswick, "confetti counting" is surely the strangest. When a check is desired on the number of tickets sold during an omnibus journey, the conductor's bell punch is opened and the tiny clippings of paper are all poured on the table. The girl, helped by a metal "finger," sorts and counts the clippings which are built up into little heaps of confetti all the same colors from which it is easy to calculate how many penny "rides" have been sold.

Foiling the Highjacker

AN extremely clever device to frustrate the motor-car holdup men is pictured here. It is a revolver holder, invented, patented, and now being manufactured by a young society woman of Pasadena, California. The device not merely holds the gun in place and at exactly the right angle for emergency pulling, but it safeguards the owner at all times from accidental discharge. It precludes firing until removed from the rod that slips into the empty cylinder, the pistol being minus one cartridge. The small metal base of the holder may be attached to the floor of the car, or upon the front plate on either side of the steering wheel. The inventor prefers her revolver holder attached to the floor, as shown in the left hand picture. This puts the handle of the weapon where she can grasp it with the same motion that a motorist must make to change gears and bring the car to a halt at the bandit's orders.

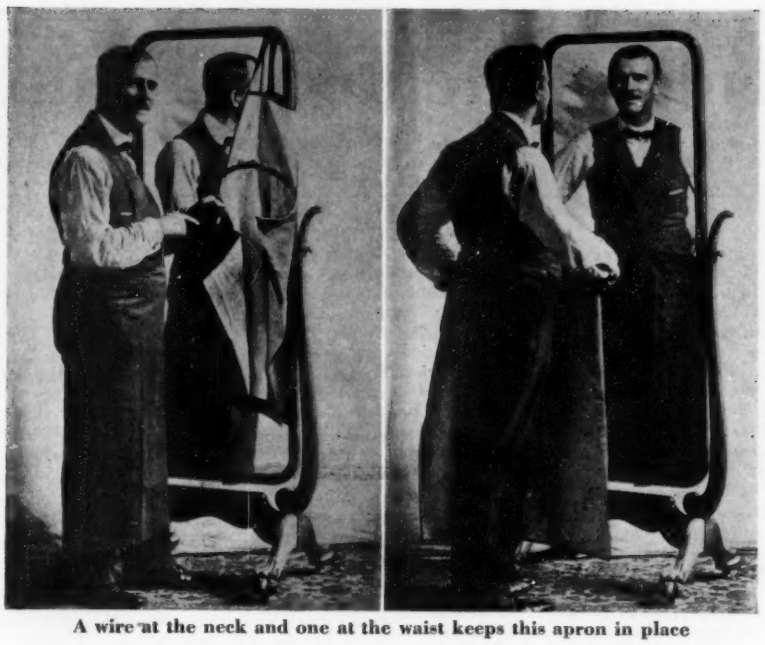


In the illustration at the left the device for holding a revolver is shown attached to the floor of an automobile. At the right it is shown attached to the instrument board

A coat hanger of unusual shape

Shaped Hangers

WE illustrate two forms of shaped hanger. The ordinary clothes hanger is so narrow and flimsy that it does as much to deform clothes as to form them. These hangers are made both in wood and aluminum. The hanger is shaped to the neck and shoulders. A painter would describe them by saying that they "were in the round," instead of "in profile." For overcoats or fur coats a more robust hanger is provided. The illustrations show the construction.



A wire at the neck and one at the waist keeps this apron in place

A Stringless Apron

A STRING in an apron is like a string in a bean—an abomination. A wire at the neck and the waist serve to keep the apron, illustrated, in proper contact with the clothing. The apron folds up very compactly.

Electric Kitchen in Cabinet

IN a wooden cabinet, no larger than a Victrola cabinet, are facilities for doing most of the work found to do around a kitchen. When completely closed its presence in a room is not objectionable.

A hanger which preserves the shape of the garment

Closing the top of the cabinet will automatically cut off the current being used by either hot plate or electric iron which is also provided. The ironing board serves as a dining table as well. When not in use it is concealed behind the cabinet. The cabinet is on rollers and can be easily moved from one location to another.

The top section holding the stovette is zinc and asbestos lined preventing any possibility of fire. Removal of stove turns this section into a sink for washing the dishes.

Hot milk holder in the form of a milk can

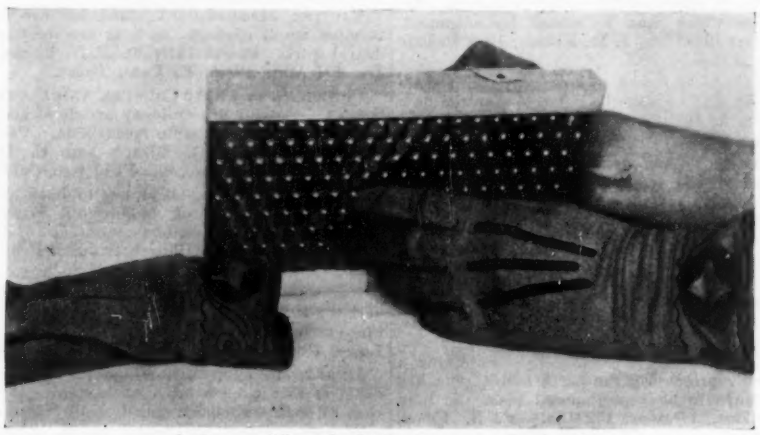
The Milk Can Glorified

THE lowly milk can has risen to high estate, and, silver-plated, forms an ornament to the lunch counter. Someone had the clever idea of making the hot milk holder in the shape of a milk can. The result is shown here.

Vegetable Slicer

THIS knife is an efficient cutter for cabbage and similar vegetables. It works somewhat on the principle of a safety razor.

An efficient vegetable cutter



A tiny washboard which slips onto the hand

Emergency Washboard

A SMALL edition of a regular sized washboard is illustrated here. An elastic tape across the back holds it securely on the hand.

This is recommended for tourists and the hallroom guests.

Cooking can be done on either an electric hot plate, located in the top, or a gas hot plate. The cabinet can be equipped for either. The one shown in the illustration is for electricity. This device can also be removed and used as a room heater in case the janitor forgets the steam.

Going the kitchenette one better

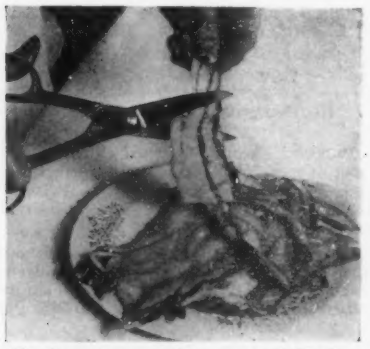
A detachable lifter for hot pans

Hot Pan Lifter

A DETACHABLE pan lifter is an exceedingly useful device to have in the kitchen. The lifter illustrated on this page grips the lip of the saucepan and relinquishes its grasp when it has reached its haven.

Efficient Kitchen Shears

AS everyone knows the kitchen would be incomplete without a pair of shears. Now, a manufacturer has conceived the idea of serrating one of the blades so that the shears cut such articles as bacon with the greatest ease.



Kitchen shears with serrated blades

Recently Patented Inventions

As a convenience to our readers, we will supply copies of any patents listed herein for 15 cents each. The official printed copies of patents include complete descriptions and drawings of the inventions disclosed. State the patent number to insure receipt of the desired patent copy.

Electrical Devices

ELECTRIC GASOLINE GAUGE.—Operated by a float to show the level of the gasoline, at any desired point, regardless of the location of the tank. Patent 1522355. B. F. Winterhoff, c/o Winterhoff Tool & Machine Co., Elkhart, Ind.

ELECTRIC TOASTERS.—In which the frame entirely encloses the article being toasted, and the casing is made of non-metallic material. Patent 1522818. A. Grouleff and H. A. Holmes, 223 E. Delaware Place, Chicago, Ill.

TIME-CONTROLLED ELECTRIC SWITCH—Which operates to close an electric circuit and maintain the same closed for a predetermined period. Patent 1523917. Y. B. Torkelsen, 96 2nd Place, Brooklyn, N. Y.

GRID CONDENSER—Adapted for use in the grid circuit of radio receiving tubes. Patent 1523893. R. C. Pitard, Jackson, Miss.

ELECTRICAL CIRCUIT FOR THERMIONIC DISCHARGE DEVICES—Whereby the sensibility of the mechanism for transmitting sound waves can be greatly increased. Patent 1523898. E. Riesz, c/o Fehlert, Loubier, Harmsen & Buttner, S.W. 61 Belle, Allianceplatz 17, Berlin, Germany.

DRY-CELL BATTERY.—The inventor has been granted two patents on a battery in which the loss of current and deterioration is pre-cluded until the same is to be applied to a consuming element. Patents 1524560 and 1524561. H. M. Koretzky, c/o Bright Star Battery Co., Terminal Bldg., Hoboken, N. J.

Of Interest to Farmers

PLOWSHARE.—Especially designed for cutting roots of a tough and fibrous character, such as are found in certain soils. Patent 1522350. W. F. Vogel and F. Lalande, c/o Challis Hardware Co., Challis, Idaho.

ATTACHMENT FOR CORN SHELLERS.—Adapted to regulate the air suction, whereby all the husks may be removed from the cobs. Patent 1521973. E. Specketer, Box 92, Galva, Iowa.

PUSH-RAKE ATTACHMENT FOR TRACTORS.—Which may be conveniently applied for use in collecting and transporting hay shocks. Patent 1521060. J. Weigel, c/o W. & W. Garage, Railroad Ave., Pittsburg, Calif.

Of General Interest

POWDER PUFF.—Made of lamb's wool or similar material, through which the powder may be gradually sifted as the puff is manipulated. Patent 1522435. L. Friedberg, c/o Furlager Mfg. Co., 67 E. 8th St., New York, N. Y.

CHART HOLDER AND FINDER.—For facilitating the tabulation and reading of columned indicia, whereby comparisons may be rapidly made. Patent 1522328. J. Rogers, 32 North Ave., New Rochelle, N. Y.

CUE GUIDE.—In the form of a slidably mounted sleeve for resting upon the hand and allowing the cue to move freely. Patent 1522321. B. R. Nyhagen, 1010 E. 178th St., Bronx, N. Y.

EGG CARTON.—For individual shipments of eggs through the mail, the carton may be readily set up or collapsed. Patent 1522325. E. L. Pitts, 60E Nebi St., Marion, Ind.

DECORATED RECEPTACLES.—Such as hat, candy, or other boxes, by the use of dyed wood of a very thin nature. Patent 1522201. S. Mittleburg, 609 Gates Ave., Brooklyn, N. Y.

PICTURE FRAME.—Formed entirely of one sheet of metal, when completed, proving both artistic and durable. Patent 1521670. T. M. Bridges, c/o Y. M. C. A., Nashville, Tenn.

STOP SIGNAL.—Adapted to be placed at streets or crossings, as a reminder to drivers crossing boulevards or main thoroughfares. Patent 1521941. G. B. Graf, 669 No. Park St., Shawnee, Okla.

PLANT SPRAYER.—Including a bottle which may be conveniently agitated to discharge its contents. Patent 1522172. F. G. Asbill, Ridge Spring, S. C.

COLLAPSIBLE CRATE OR COOP.—Adapted for shipping purposes or as a poultry coop, of all metal construction, and sanitary. Patent 1521936. W. A. Fadden and H. B. Nielson, 1126 Utah Ave., Butte, Mont.

FILING DEVICE.—Wherein co-operating means are utilized to facilitate the attachment of the papers to the base of the device. Patent 1522429. A. A. Ferle, 427 W. 34th St., New York, N. Y.

FILING DEVICE.—Which securely retains papers in filed position, and receives a maximum number of papers. Patent 1522430. A. A. Ferle, 427 W. 34th St., New York, N. Y.

BURGLAR ALARM.—A portable device, designed for attachment to doorknobs, sounding an alarm if the knob is turned. Patent 1522,419. A. E. Coyne, 29 Waverly Place, New York, N. Y.

BINDER.—Having means for preventing the leaves from slipping, yet permitting convenient turning. Patent 1522409. R. T. Berry, c/o M. C. Jackson Co., 78 Walker St., New York, N. Y.

COMBINATION COMMODE SEAT.—Conveniently accommodating either adults or children as occasion demands. Patent 1520301. C. B. Michel, 1421 24th Ave., Oakland, Calif.

KNOCKDOWN BARREL.—Constructed entirely of sheet metal, using as few as four pieces which may be nested for shipment. Patent 1521108. J. H. Killion, 1628 Prairie Ave., Chicago, Ill.

VALVE.—Adapted to co-operate with seats at opposite ends of the valve to stop the flow of water in a main. Patent 1521724. H. Sour, 519 Kirby Place, Shreveport, La.

CHALK RAIL FOR BLACKBOARDS.—Provided with a screen which sifts the customary chalk dust, into a well for collecting the same. Patent 1521059. W. H. Weeks, 215 Santa Clara Ave., Oakland, Calif.

HOT WATER VALVE.—Having simple means for holding the key in place, and the stem so that it will properly function. Patent 1522353. O. L. Whiteman, c/o American Valve Co., Coxsackie, N. Y.

EDUCATIONAL APPARATUS.—Comprising a globe representing the earth and a plurality of maps to be superimposed upon the land portions. Patent 1523188. C. S. Flood, Hotel Griswold, Cleveland, Ohio.

WINDOW SASH.—In which the glass is held on an inner frame hingedly mounted and arranged to slide in the ordinary way. Patent 1522843. W. Strang, 3085 Bonfield St., Chicago, Ill.

TOILET-SEAT COVER.—Cheap to manufacture, entirely covering the seat, and foldable into compact form for the market. Patent 1522699. W. J. Reid, 25 W. 42nd St., New York, N. Y.

TOY MOTION-PICTURE APPARATUS.—For the successive display of pictures either by direct view or by the casting of light reflections. Patent 1523274. J. P. Muller, 79 Rockdale Ave., New Rochelle, N. Y.

Hardware and Tools

CARPENTER'S MEASURING TOOL.—By means of which the difference in length of the jacks for rafters at predetermined centers may be calculated. Patent 1521980. P. W. Zook, 1118 W. Church St., Urbana, Ill.

HAND TOOL.—Particularly adapted for use in connection with valve grinding, giving intermittent rotary motion in opposite directions. Patent 1521968. A. J. Richards and F. J. Siedenburg, 4601 Ave. M., Brooklyn, N. Y.

FISHING TOOL.—For gripping a sucker rod when the space between the rod and the well tubing is very limited. Patent 1521789. E. V. Oswald, c/o Universal Con. Oil Co., Lost Hills, Calif.

CAN OPENER.—Provided with an adjustable cutter and holder, so that it will operate on cans of different sizes. Patent 1522,319. G. T. Nolan, 1301 Custer St., Laramie, Wyoming.

SWAGING TOOL.—To be used in connection with a pneumatic hammer for turning over the ends of boiler tubes. Patent 1521805. P. Ellis, c/o Lombard Iron Works & Supply Co., Augusta, Ga.

WRENCH.—The slidable jaw of which is adapted to be adjusted along a handle carrying a fixed jaw. Patent 1522432. J. H. Fones, 27 Locust St., Larchmont, N. Y.

VALVE LIFTER—So adjusted that it may be applied to springs of various widths and lengths. Patent 1523706. C. E. Newson, 638 W. 3rd No. St., Salt Lake City, Utah.

Machines and Mechanical Devices

TYPEWRITER.—The invention relates more particularly to typewriter carriages to be depressed for printing after being revolved. Patent 1521408. S. A. Thompson, c/o Simplex Typewriter Co., 210 11th Ave., New York, N. Y.

PLAITING MACHINE.—For plaiting skirts, ruffles, panels, forming accordion, side, box plaits or the like, used in wearing apparel. Patent 1518670. Mae Noel, c/o Mrs. W. H. Gersel, 4228 4th St., N. W., Washington, D. C.

SAND TRAP FOR OIL WELLS.—Having means for collecting the sand suspended in the oil, and preventing it from dropping on the working barrel. Patent 1519042. G. A. Osborne, Box 1493, El Dorado, Ark.

CASTING MACHINE.—Adapted for use in forming small castings, such as are used in dental work. Patent 1518630. F. N. Brown, Jr., 407 Mills Bldg., El Paso, Texas.

COMBINATION FRUIT CRUSHER AND FLOUR SIFTER.—Providing a culinary article of general utility having simple mechanism. Patent 1517624. A. G. Girard and E. R. Moeller, 730 22nd Ave., San Francisco, Calif.

ENVELOPE OPENER.—Adapted to open an envelope by cutting off one of the edges, without injuring the contents. Patent 1517,625. R. Glasser, 294 Church St., San Francisco, Calif.

PULVERIZING MACHINE.—Adapted for pulverizing fibrous materials which require definite cutting as well. Patent 1517564. S. K. Lowe, 701 Grant Ave., San Francisco, Cal.

HYDRAULIC CONVEYER.—Especially applicable to use in connection with stone quarries, to enable workmen to get readily to the solid rock. Patent 1518528. H. T. Libby, 843 N. Greenwood Ave., Kankakee, Ill.

HEMP-STRIPPING MACHINE.—Adapted to be readily transported about a plantation, and easily operated to strip the hemp leaves. Patent 1519579. P. H. Frank and W. H. Gohn, 19 Helros, Cosmopolitan Bldg., Manila, P. I.

DEVICE FOR DRAWING OFF LIQUID PORTIONS OF DESIRED DENSITIES.—The device is adjustable so as to draw off the liquid at any desired depth. Patent 1519461. W. B. Livingston, 603 N. Clark St., Chicago, Ill.

GRIPPER FOR PRINTING PRESSES AND PAPER-USING MACHINES.—Easily positioned and at the same time presenting a resilient gripping action. Patent 1519944. A. W. Warsen, 50 Ashford St., Hartford, Conn.

SPINDLE FOR GRINDERS.—Of such character as to permit of the changing of the grinding wheel without disturbing the ball bearings. Patent 1519921. J. P. Lange, 511 Passaic Ave., Passaic, N. J.

GOVERNOR.—Applicable not only to steam engines but electric generators and motors used in association with elevators. Patent 1519853. O. G. Lissen, 151 Highland Ave., Jersey City, N. J.

TURNOVER MACHINE.—For inverting tubular articles or fabric belts without injury to the article or the services of skilled operators. Patent 1520644. L. Goldstein, 179 Herze St., Brooklyn, N. Y.

MATERIAL-HANDLING APPARATUS.—Especially adapted for mine-plants for loading bulk material into cars or transporting devices such as conveyor belts. Patent 1520,652. L. D. Jenssen, c/o Bryns Patentkontor, Tostrupgaarden Christiania, Norway.

PISTON-RING-CONTRACTING DEVICE.—For use in connection with piston rings of different widths. Patent 1520393. C. Barchus, Natchez, Mississippi.

Pertaining to Vehicles

HEADLIGHT GLARE SHIELD.—Which may be manually operated to deflect the light rays laterally from an approaching driver. Patent 1518112. W. G. Ruscoe, P. O. Box 311, Stamford, Conn.

DEMOUNTABLE RIM.—When in operative position, will be securely held against lateral or circumferential displacement with respect to the wheel. Patent 1518047. A. W. Bumstead, 482 East St., New Britain, Conn.

GASOLINE CONTROL FOR AUTOMOBILES.—Which reduces the consumption of gasoline, the carbonization of the cylinders, and the dilution of crank case oil. Patent 1516040. W. A. Garlick, 411 Alexander Bldg., San Francisco, Calif.

SAFETY ATTACHMENT FOR TRACTORS.—Readily assembled or disassembled, and adding strength, rigidity, and durability as well as general effectiveness. Patent 1517323. P. O. Trahan, Gueydan, La.

COMBINED LAND AND WATER VEHICLE.—Serving as an automobile, but capable, without adjustment of driving off the land into the water and serving as a power boat. Patent 1517422. L. G. Hall, Downers Grove, Ill.

CLOSURE-CAP ANCHOR.—Which will prevent accidental loss of the closure cap of a fuel tank of an automobile. Patent 1518467. J. D. Van Pelt, 260 Bordentown Ave., So. Amboy, N. J.

REAR AXLE CONSTRUCTION.—Whereby a rear axle housing may be formed of aluminum, magnesium alloys, such as magmalite, lynnite, and the like. Patent 1519043. V. W. Page, c/o Victor Page Motor Corp., Melrose Ave., Stamford, Conn.

TIRE CARRIER.—Having means whereby the same may be employed for contracting a tire rim preparatory to removing the tire from the rim. Patent 1518295. D. B. Baima, 1362 Delaware Ave., Detroit, Mich.

ROAD LEVELER.—In the form of an attachment for tractors operating to cut off protuberances on a surface traversed. Patent 1518505. B. W. Gray, Belmont, Wis.

WHEEL JACKING METHOD AND DEVICE.—By means of which a jack may be applied near the end of a leaf spring with apparently no sag of the spring. Patent 1517648. J. T. Larson, 1124 Piedmont Ave., N. E., Canton, Ohio.

TRACTOR.—In which the driving force may be transmitted to the several ground gripping members coincidentally and equally. Patent 1518465. W. F. Sternberg, Piper City, Ill.

LOCKING MEANS FOR RIMS.—Which may be associated with any standard type of wheel for locking a demountable clincher ring. Patent 1518693. I. V. Da Silveira, R. F. D. No. 1, Fallon, Nevada.

RADIATOR FOR INTERNAL-COMBUSTION ENGINES.—For use in connection with motor vehicles, whereby cool air may be circulated to carry off the heat collected. Patent 1518,777. W. J. Drucker, 9110 St. Charles St., Woodhaven, L. I., N. Y.

AUTOMATIC SAFETY TRACTOR DEVICE.—Arranged to cut off the power, in the event the tractor is tilted beyond a predetermined angle. Patent 1519079. E. H. Whiting, Route 3, Box 501, Santa Rosa, Calif.

FLUID-TRANSMISSION DEVICE.—For use in connection between the crank shaft and the rear wheels in lieu of the usual transmission gears. Patent 1518797. W. E. Kay, 422 E. Broad St., Elyria, Ohio.

TRUCK—Of such nature that it will allow of convenient handling of a large slab of concrete for constructional purposes. Patent 1519037. C. T. McPhalen, 919 8th Ave., E. Vancouver, B. C.

WAGON AND TRUCK DUMP.—These patents provide an attachment whereby the same dump can be used for dumping a wagon or a truck, and will regulate the descent of the wagon as it is being dumped. Patents 1520,295 and 1520296. E. D. McCallough and A. W. Butcher, c/o The Gravity Dump Mfg. Co., Abilene, Kans.

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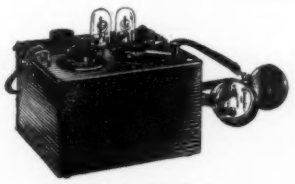

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Conducted by Albert G. Ingalls

A Drilling Race for the Deepest Well in the World

OWING to the most remarkable success of a very deep gas well east of Pittsburgh, Pennsylvania, which for over three years has been producing half a million cubic feet of natural gas per day, two other deep wells are now being drilled in the same part of the country in the hope of finding gas in immense volumes underneath the great anticlinal folds of the Allegheny Mountains. In order to reach the desired strata of rock it may be necessary to drill to a depth close to ten thousand feet.

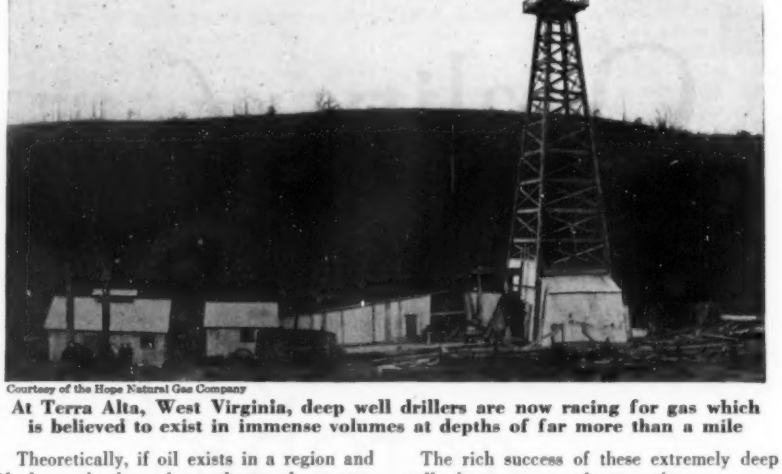
Drilling in the folded Appalachian Mountains to such record depths for natural gas has as its basis the Anticlinal Theory of Dr. I. C. White, State Geologist of West Virginia, a widely recognized authority on oil and natural gas. Everyone who has been approached by salesmen of oil stock has heard much of the geological term anticline; and it is a fact that oil is found frequently under the arched folds of rock thus termed. Theoretically, if oil exists in a region and if the rocks have been thrown by nature into a sort of folded washboard, the oil should be found underneath the ridges of strata rather than underneath the valleys of the strata. This is because oil is lighter than the ground-water in the rock. Hence it is sometimes found floating on it, confined laterally by the sides of the rooflike anticlinal ridge.

If in addition to water and oil, there is gas, it is apt to be found floating highest of all, close up under the anticlinal ridgepole, for the reason that gas is still lighter than oil. The anticlinal theory was first propounded by Dr. White in 1885, and it has since become famous. It has served both as an excellent working basis on which geologists hunt for oil, and, through no fault of its proponent, as a practical working basis on which many dishonest oilstock salesmen have brought to light much gold in the form of widow's and orphan's mites. If oil actually exists in a region of folded rock strata it is most apt to be lodged under the anticlines, it is true; but the mere existence of anticlines is no assurance that there is oil under them.

Geologists know that much natural gas has been derived from the Oriskany sandstone of Ohio and other localities. When one goes as far south as the general locality of Pittsburgh and West Virginia, however, the Oriskany sandstone lies buried by other rocks, thousands of feet beneath the surface. This is because the rocks dip, as a whole, toward the south. Why not drill, then, as far as the deeply buried Oriskany sandstone, hoping that its great anticlinal folds will contain immense volumes of natural gas, pocketed by the adjacent folds?

About four years ago the People's Natural Gas Company (Pittsburgh) made a test of the anticlinal theory. At a point close to the Lincoln Highway, thirty-five miles east of Pittsburgh, they drilled in Ligonier Gap a gas well 6,822 feet deep. At this depth the characteristic Oriskany sandstone was struck and after a further penetration of only six inches a flow of nearly one-half million feet of natural gas per day was obtained. The truth of the anticlinal theory was thus demonstrated.

Because this well was so successful the same company put down another well close by and found gas in still lower rocks, perhaps the equivalent of the Clinton or Medina sandstone of Ohio, at a depth of 7,430 feet.



Courtesy of the Hope Natural Gas Company

At Terra Alta, West Virginia, deep well drillers are now racing for gas which is believed to exist in immense volumes at depths of far more than a mile

The rich success of these extremely deep wells has encouraged two other gas companies to try for deep anticlinal gas wells in the same region of the folded Appalachian Mountains. The Hope Natural Gas Company (Pittsburgh) began a well at Terra Alta, West Virginia, just over the border from the western leg of Maryland. This well is still being drilled, having reached in January a depth of about 3,000 feet, according to the statement of Mr. Jno. B. Corrin, vice-president of the Hope Natural Gas Company. At this depth the earth temperature proved to be ninety-six degrees, Fahrenheit, and it was gradually increasing with greater depth. This company has also drilled two other deep wells, the Goff well which reached a depth of 7,386 feet, and the Lake Well which reached 7,579 feet.

Anxious to secure some of the possible financial returns from the discovery of large volumes of gas near a great manufacturing center, a third company, the Reserve Gas Company, now is attempting some superdrilling. In West Virginia, between the cities of Weston and Clarksburg, a deep well has been begun.

The drilling of extremely deep wells, which to be logical one should call subdrilling rather than superdrilling, is very costly, the expense increasing very rapidly as the depth increases.—*Natural Gas* (Cincinnati, Ohio), vol. 5, pages 3-6 (Sept., 1924), and pages 29-31 (Dec., 1924).

Shoveling Snow with T. N. T.

SNOW that buries some of the mountain roads of the western states many feet deep during the winter will make a sudden departure from its resting place in the spring if experiments that are being tried with explosives for snow removal result as planned.

According to a statement issued by the American Automobile Association, which is making a strong drive for winter snow removal from important motor highways, T. N. T. was strung last fall along some of the localities known from previous experience to drift worst, and was permitted to drift under the snow. This explosive was prepared in the special form known as Cordeau fuse. This is a long tube of lead containing a ribbon of T. N. T. of indefinite length. The free ends of the explosive fuse, which unlike the commonly known type of fuse does not merely burn but instantly explodes over its entire length, are raised on poles some twenty-five feet above ground level, the ends being made water tight.

In addition to the long fuse itself, in a few very seriously drifted localities fifty-pound boxes of twenty percent dynamite were placed at twenty foot intervals, the boxes were opened and the Cordeau fuse run through them.

In the spring, when the last snowfall has occurred, the long explosive snake will all be detonated at once, and if, as hoped, the snow instantly flies from the highway, like the dirt from a long ditch excavated by means of explosives, the new method will be used on a larger scale after subsequent winters.

The American Automobile Association contends with reason that the surrender of our through highways to winter snow obstruction is really a sort of hang-over from a period when man could not travel far during the winter if he would. Today, while snow removal from long inter-city highways is expensive, it is still more expensive to give up the advantage of getting about rapidly, transacting business, and so on, conferred upon us by the development of the individual, power-driven vehicle.

A map issued by the association indicates by contours the annual snowfall of every part of the country, as well as the extent to which the various states have adopted snow removal programs. The snow removal work would appear to extend in a fairly definite unbroken zone from Massachusetts to as far west as Colorado. West of Chicago this zone includes Northern Illinois, and particularly Iowa, Nebraska, Colorado and Utah. The state of Washington also has a well developed but isolated snow removal plan, according to this map, while to a lesser degree snow is being removed in Wisconsin, Minnesota, New Mexico, Arizona and Nevada.

The northeastern states which have snow removal programs form a large block extending from Chicago, south half way across Indiana, then east to Richmond. This thickly populated area has a less difficult problem than some of the Rocky Mountain states where the annual snowfall is about five feet in the valleys traversed by highways. On the Rocky Mountain ridges there is as much as twenty-eight feet of snow but no effort is being made to remove it in such extreme cases.

* * *

Glass Substitute That Transmits Ultra-violet Light

A NEW kind of glass, of organic origin, which is reported to permit the passage of ultra-violet light has recently been perfected by two Austrian scientists, Herr Pollak and Herr Ripper. The new glass is called Pollopas, and it is made by a chemical condensation of urea with formaldehyde. Pollopas is considerably lighter than ordinary glass, weighing about one and one-half times as much as an equal volume of water, while common glass often has triple this weight. It is quite soft, being somewhat softer than mother of pearl, and is easily abraded. It is very transparent.

The first form of the product obtained in the manufacture is a liquid, but under the action of heat it is solidified and acquires the properties of a special glass. It may easily be worked into all kinds of curves, is not soluble in either water or alcohol and is so homogeneous that it may be used for many optical purposes. Its index of refraction varies between 1.9 and 1.54, or about the same as that of rock crystal.

Pollopas may be colored easily by boiling it for a few minutes in a heated alkaline solution of the coloring matter. It will be employed in the manufacture of toys, of various objects of finery, to make automobile windshields, and for greenhouse panes. The fact that it is permeable to ultra-violet light may make it especially valuable in the growing of plants indoors.—*Nature* (Paris), Jan. 3, 1925, page 1.

* * *

The Rarest Bear in the World

How the capture of a young bear cub settled a scientific dispute of long standing is told by Francis Dickie, in *American Forests and Forest Life* (Washington, D. C.). It seems that for twenty years scientists have been at odds as to whether a very rare white bear found only on two small islands near Prince Rupert on the coast of British Columbia was a distinct species or simply an albino. If the former, it would be the rarest bear in the world. If the latter, it was simply a polar bear altogether lacking in pigment.

Reproduced from "American Forests and Forest Life"
The cub that had brown eyes, a new species

Early last September two Indians landed on the wild shores of one of these two islands in search of game and came upon a mother bear with two cubs, one of which they succeeded in capturing alive. This bear finally reached Francis Kermode, Director of the Museum at Victoria, British Columbia.

When the cub was received the very first thing the director did was to lift the head of the friendly little animal to the sunlight. When he looked into its eyes he knew the cub was far from being an albino specimen of the polar bear. Its eyes were distinctly brown. Thus, it is a new species. The bear has been named *Ursus Kermodei*, for the director.

For many years the skins of these white bears have been brought to the world's fur markets. It was long ago noted by Dr. W. T. Hornaday, Director of the New York Zoological Park, that certain characteristics of the skins showed they were not those of the common polar bear.

Yet, in order to base a new species, more evidence than this was necessary. This evidence in the form of the live cub recently captured now establishes the new species, which is far smaller than the polar bear and even much smaller than the common black bear. The teeth differ greatly from those of the polar bear, while the ears are smaller.—*American Forests and Forest Life* (Washington, D. C.), vol. 31, page 38 (Jan., 1925).

Turning Mud and Oyster Shells Into Cement

NEAR the shores of San Francisco Bay, in California, a natural sub-aqueous mixture of clay silt and oyster shells is being dredged up from the bottom of the bay, and made into portland cement just as it occurs in nature, and without the addition of any other elements. Luckily these two products of nature, the clay and the shells, represent, chemically, just the same products in about the same proportions that usually have to be quarried from the solid rock.

Portland cement is generally made of a ground-up mixture of limestone and shale, although in some places it is more economical and convenient to use other materials having an equivalent chemical composition. For example, in a few places portland cement is made from mixtures of marl and clay. Marl is the equivalent of limestone, both materials being forms of calcium carbonate; and shale is simply consolidated clay.

Sometimes pure limestone and clayey or argillaceous limestone are mixed artificially and burned into cement. Some of these substitutes for the more commonly used cement-making materials may be found already prepared. Sometimes, however, it is more costly to prepare such materials as marl, which being soft requires little grinding, but which must be dried and rid of organic impurities before it can be used, than it is to grind up its equivalent weight of solid limestone. In the new San Francisco Bay cement plant the shells, which like rock limestone are nearly limestone element is supplied by the oyster pure calcium carbonate; and by the clay which provides the aluminum silicates and iron for the cement.

The mixture of shells and clay are brought up from the bottom of the bay by means of a hydraulic or suction dredge having a discharge pipe sixteen inches in diameter. This pipe empties the material directly into barges alongside the dredge, and when these barges are filled they are towed ashore to the unloading wharf at the cement plant.

The great dredge is operated by only six men, whereas, if the material from which the cement is being made were quarried in the usual manner, that is, in the form of solid limestone and shale, seventy-five or one hundred men would be occupied doing the work that is now done by the dredge.

Thus, the method of securing the necessary materials from the easily accessible source at the bottom of the water makes possible a considerable saving in the cost of manufacturing portland cement. Rivers flowing from the hills and mountains bring the clay and lightly deposit it in the bay, oysters move in where they find such ideal conditions for their growth and nourishment, and thus, man finds the materials for making one of the greatest necessities of modern civilization close at hand, ready to take away and all prepared in the proper proportions for making cement.—*Rock Products* (Chicago), vol. 27, pages 17-20, Nov. 29, 1924.

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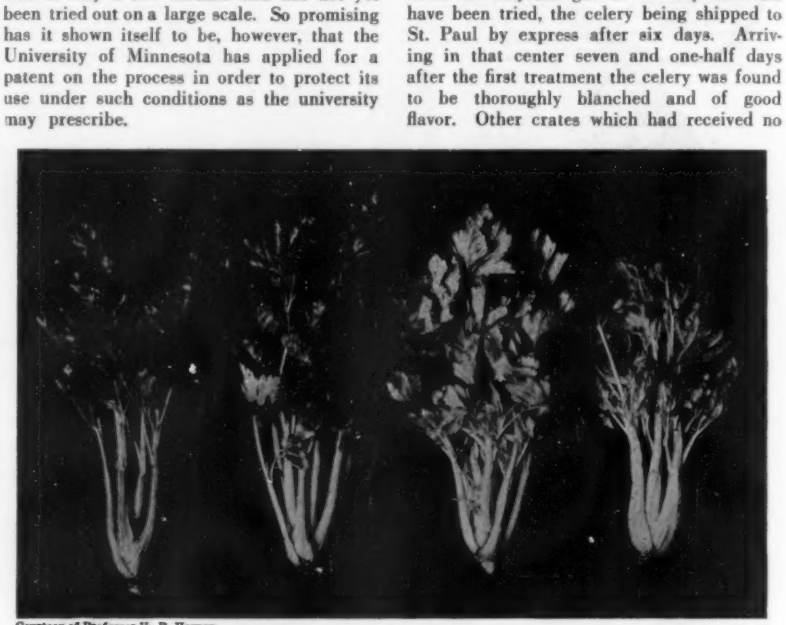
Gassing Celery for Market, a Newly Discovered Process

CELERY growers will no longer have to bank their celery in the field in order to blanch it, for a group of experimenters of the University of Minnesota (St. Paul, Minnesota) have developed a short-cut method of doing the work indoors or even in the cars during the transportation of the celery to market, by means of ethylene gas. Ethylene is the same gas which is used for bringing the desirable colors to the skins of lemons and oranges.

The new celery blanching process has been known only a few months and has not yet been tried out on a large scale. So promising has it shown itself to be, however, that the University of Minnesota has applied for a patent on the process in order to protect its use under such conditions as the university may prescribe.

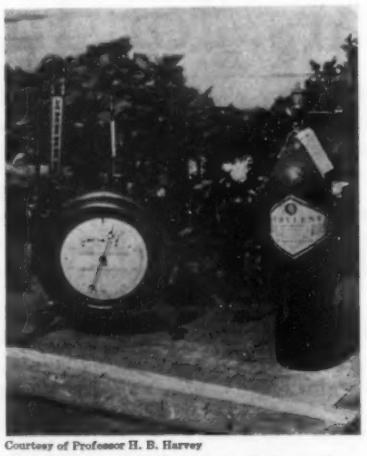


Courtesy of Professor H. B. Harvey

CONTRASTS IN BLANCHING

These contrasts show up poorly in half-tone reproduction. The dark green plant (note foliage) at extreme left was not blanched. The second plant was blanched in soil for one month. The third received six days ethylene treatment; while the fourth was overblanched

In a paper read by Professor R. B. Harvey, of the Section of Plant Pathology of the University of Minnesota, before the recent meeting of the American Association for the Advancement of Science the newly discovered celery blanching process was fully described. Last summer, owing to the prevalence of cloudy weather, celery made a poor growth and frost came too early to permit proper blanching. On the wings of this adversity came the new discovery.



Courtesy of Professor H. B. Harvey

Measuring the dose of ethylene for a celery storage room

Ethylene gas is not only non-poisonous, but it is used as an anaesthetic by surgeons. Owing, however, to the fact that in blanching celery the gas is used in concentrations which are thousands of times weaker than those used in surgery, there is practically no danger connected with its use for the former purpose. Since ethylene is inflammable it must be kept away from fire. Although inflammable, it is not explosive in the weak concentrations used.

When the celery, placed in crates ready for shipment, is stored for six to ten days in a chamber containing the proper concentration of ethylene gas the leaves and stalks lose their green color and take on the fine golden hue of celery that has been blanched either by hilling up in the field or by long time storage. Not only is the color affected, but the celery becomes brittle and sweeter.

Yellow and red pigments are not affected at all by ethylene, but the bitter green pigment called chlorophyll is broken up by it. It is claimed that the new treatment renders even the leaves sweet and edible.

Experimental treatments on a basis of two doses of ethylene gas at two-day intervals have been tried, the celery being shipped to St. Paul by express after six days. Arriving in that center seven and one-half days after the first treatment the celery was found to be thoroughly blanched and of good flavor. Other crates which had received no gas treatment were included with the shipment to act as a check test. These arrived with green stalks and tops.

Since the blanching effect continues to go on after the celery has been taken out of the gas it is believed that the actual time of gassing may be decreased in regular practice to three days. If this becomes practical we may find it possible to dig celery from the field, load it into gas-tight refrigerator cars, gas it in the cars during transit and thus, put it on the market several weeks earlier than has heretofore been thought possible.

The treatment, according to the statement of Professor Harvey, should not be attempted by growers of celery without the aid of the Experiment Station of the University of Minnesota.

* * *

What Will Future Man Be Like?

SIR ARTHUR KEITH, whom most scientists place in the front rank of the world's great anthropologists, opposes the oft-repeated belief that future man will be only a thinking machine, with most or all animal instincts suppressed. Sir Arthur, who is Professor of Anatomy at the Royal College of Surgeons (London), does not believe life would be worth living if our animal instincts were not strong. Though we deify the contemplative, intellectual and spiritual life and often succeed in deceiving ourselves into the belief that we have mortified the flesh, still we live by animal instincts more than we realize.

Says Sir Arthur, according to a cable dispatch to the New York *Times*, "The man of tomorrow will not be a creature all intellect. He will have a strong constitution and retain a lot of animal in him." He stated that hyper-intellect caused more pain than pleasure and suggested that if all human beings became hyper-intellectual the end of the race might rapidly ensue. Animal instincts, on the other hand, were what kept human beings alive. "We have," he continued, "about ten times more power of brain and intellect

than we are ever likely to need. Most people go about using only a very small portion of their brains. Only once in a blue moon do you find an instance of a man using the full capacity of his brain."

Sir Arthur, perhaps the greatest living authority on the aspect of man's past evolution, especially in connection with his anatomy, and author of the well-known work, "The Antiquity of Man," a new and revised editon of which is now in preparation and will doubtless be reviewed in these columns when it appears, makes a practical analysis of man's intellectual and animal tendencies, using as a basis for this analysis the newspapers man reads. The modern newspaper is an exact reflection of the average man's nature. This is because competition among newspapers enforces a close study of what the readers want.

"The newspaper," says Sir Arthur, "deliberately sets itself the task of suiting popular taste, and if you take a Sunday newspaper with a large circulation, you get an idea of the proportion of man's interest in intellectual matters as compared with human matters."

"Even the most intellectual paper does not give more than three percent of its space, I suppose, to intellectual matters."

Thus, through the sayings of a famous anthropologist we once more get both feet on the earth. Man's brain has ever increased, since the time of the ape Propliopithecus, his probable Oligocene Epoch ancestor, several millions of years ago. Yet there appears to be a limit to the need of increase in brain size.

What we are doing in our great modern age of learning is not increasing the size or the working capacity of our brain, but rather, accumulating the knowledge of specialists on many subjects and making our advances through a comparison of these records.

The ancients were far afield when it came to the facts of science, chiefly because they sought truth only by reasoning instead of by empirical methods coupled with reasoning. Yet if one inclines to discount their actual brain capacity, the ability to think deeply, let him read Plato's Dialogues.

The depiction of future man, hairless, a vast dome balanced on an atrophied body, all animal instincts crushed—in short, a pure thinking machine, is the dream of the writer of fanciful scientific fiction. Man's brain is sufficiently large—all he now requires is to use it.

* * *

What Road Dust Really Is

CHEMICAL analyses of road dust sucked into the air-cleaners of motor cars running in several different states show that while the composition of the dust varies considerably from state to state, there is very little difference in its abrasive quality. Road dust that passes through the carburetors and into the cylinders of the engine is injurious, acting as an abrasive.

At a recent meeting of the Society of Automotive Engineers, Mr. C. E. Summers described analyses and experiments he had made on common road dust. Most of the content of the dust is silica (sand is one kind of silica and is of about equal hardness with steel). Therefore the common expression "putting sand in the bearings" might well be altered to read, "letting road dirt get into the cylinders."

Contrary to popular opinion, states Mr. Summers, dust is not in itself a light substance. The ability of dust to float in the air for a length of time depends on its small size rather than its specific gravity. The smaller it is, the easier it floats. This is due to the greater ratio of area to volume as the size of the particle grows less. For very small particles, the viscosity of the air is an important factor in floating.

Road dust particles vary from the coarsest material down to tiny crystals that are just visible with a microscope of 500-diameter magnifying capacity. The coarsest dust particles that an automobile may draw in when following closely or passing another car may be one hundredth of an inch in diameter. Two minutes after a vehicle has passed, however, particles larger than one five-thousandth of an inch will have settled. In order to scratch the inside surface of the cylinder the dust particles must be larger in diameter than the thickness of the oil film of lubrication.

Many previous tests have been made on the effect of dust drawn into the cylinders with the incoming charge of gas, but instead of making these tests under actual road conditions, such as Mr. Summers' method of actually driving a car across two states with another car close ahead all the way, fine sand has been used and the tests have been made in laboratories. But ordinary sand is much coarser than road dust. In other cases dust much finer than average road dust has been employed in making tests on the wear caused by the omission to provide cars with air-cleaners.—*Automotive Industries* (New York), vol. 52, pages 191-193 (Jan. 29, 1925).

* * *

Will the Blighted Chestnut Tree Come Back?

BY repeated grafting, hybridization and vaccination it is hoped that chestnut trees having an immunity to the chestnut blight or chestnut bark disease which has destroyed most of the trees of this variety in the United States since the disease became rampant in 1904 will be developed. Experimental work that has been done and is still going on provides fairly good reason for the belief that the chestnut, apparently gone forever, will, after all, come back.

Twenty-one years ago the chestnut blight was first noticed in a tree in the New York Zoological Garden. From this center the blight spread, advancing year by year like a glacier, slow but sure, until today there are few chestnut trees of commercial lumber size left. The blight has now reached Georgia and it is also close to the western limit of the chestnut's natural range. Everywhere that chestnuts once grew, their gaunt, leafless skeletons stand naked of bark against the horizons. To all appearances the tree is doomed forever.

Appearances often mislead, however, and it now begins to look as if there was fair hope that a new blight-resistant variety of chestnut tree will be developed. So says Joseph S. Illick, in recounting the good work of Dr. G. A. Zimmerman whose mountainside home near Piketown, Dauphin County, Southeastern Pennsylvania, has for six years been the center of many significant experiments on chestnut trees.

Dr. Zimmerman says that "tree diseases

From "American Forests and Forest Life"

Dr. Zimmerman and one of his blight-resistant Japanese chestnut trees, already bearing fruit

in many respects are like human diseases. We know there are persons who escape infection, even though they have been freely exposed." When the plant breeder wishes to develop some disease-resistant vegetable, for example asparagus or cabbage, he searches a badly blighted field of these vegetables for the few plants that appear to

be immune from attack. With these as his materials he crosses them and selects from their offspring the individuals which show increased disease resistance. In this manner varieties that are comparatively free from disease are gradually developed.

Dr. Zimmerman is doing the same thing for the chestnut. He is a physician who formerly specialized in human immunology. Therefore, it was natural for him to turn to chestnut immunology, for many of the principles are common to both.

Dr. Zimmerman's work is not yet finished, but enough has been done to show that there is good expectation that the chestnut which has seemed doomed forever in America, will come back. That has been the history of human plagues, the few survivors recreating a comparatively immune community. Dr. Zimmerman has shown already that while the common American chestnut and the European chestnut are very susceptible to the destroying pestilence, the western chinquipin, the Chinese chestnut, and the Japanese chestnut are resistant to blight.

In regions which were swept by the chestnut blight five to ten years ago, new sets of sprouts have followed the death of the mother tree tops. There is a marked difference in the resistance of some of these survival sprouts. It seems quite plausible that these sprouts mark an effort on the part of the trees to build up resistance to the blight.

Dr. Zimmerman, who is making his life a devotion to the salvaging of the chestnut tree, has all obtainable species, varieties and hybrids of chestnuts in the old and new world growing on his place. Many of these trees were sent him by other tree experts in this country, in Europe and in Asia.—*American Forests and Forest Life* (Washington, D. C.), vol. 31, pages 7-9 (Jan., 1925).

men that chipped out the crudely worked flints of Foxhall.

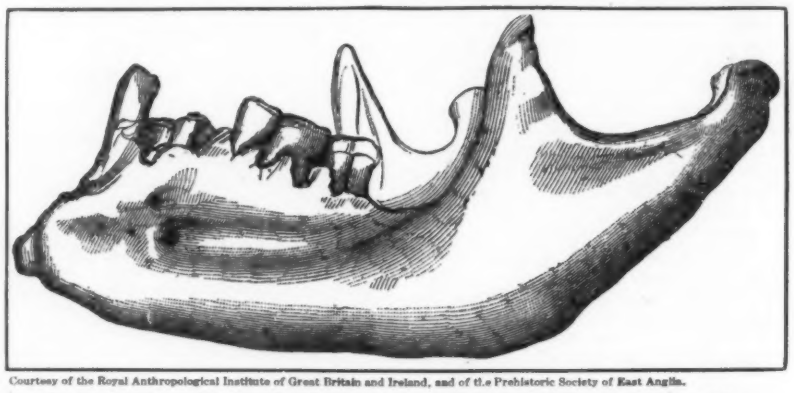
In the *Anthropological Review* for 1867, Mr. Moir found a forgotten account of the circumstances surrounding the discovery of a fossil human jawbone and of the fruitless attempts of that day to interest science in it. The jawbone was said to have been found at a depth of sixteen feet under the earth, in the same Red Crag deposits of Pliocene age which produced the Foxhall flints just mentioned.

At the time of the discovery of the fossil, in 1855, these deposits were being excavated extensively in order to recover for fertilizer the rolled lumps called coprolites. Fossil bones and teeth of mastodons and other animals were frequently found and the workmen were instructed always to turn these fossils over for scientific examination.

It would appear that a laborer found what is now called the Foxhall jawbone and traded it to an Ipswich druggist for a glass of beer. The druggist, an intelligent man, turned the jawbone over to Sir Thomas Bart, who later forwarded it to a Dr. Collyer.

Dr. Collyer, concerning whom we now know only that he was educated in the practice of medicine at the Medical College of Pittsfield, Massachusetts, and that he took over a medical practice in England, failed in his attempts to interest the scientists of that day in what must have seemed at that time a piece of nonsense. Science did not then unreservedly accept even the flints of the old stone age. The time was far from ripe for an appreciation that man could have existed as long ago, or anywhere near as long ago, as Pliocene times.

There is some reason to think that Dr. Collyer returned eventually to America, taking the Foxhall jawbone with him. From this time on, it drops from sight.



Courtesy of the Royal Anthropological Institute of Great Britain and Ireland, and of the Prehistoric Society of East Anglia.

Can you trace this invaluable fossil, probably forgotten in some attic?

Lost, a Million-year-old Jawbone

SOMEWHERE, perhaps under the rafters of some ancient American attic, there is a lost human jawbone almost a million years old, for whose recovery anthropologists would be exceedingly grateful. This is the lost jawbone of Foxhall, England, first found as long ago as 1855, but discarded because in those early days science was not prepared to appreciate its inestimable scientific worth. There are good reasons to believe that this fossil bone was brought to America before it finally disappeared. All trace of it was lost, however, when knowledge of its last known possessor, a Dr. R. H. Collyer, was lost. Perhaps you can help science to find it.

First, however, let us provide a brief account of the circumstances under which the bone was found. In Eastern England, in East Suffolk, the anthropologist J. Reid Moir has for several years been finding many remains, chiefly in the form of chipped flint implements, of a most ancient race of men who are thought to have lived there in upper Pliocene time, that is, before the beginning of the Glacial Epoch.

Mr. Moir has worked on these deposits for many seasons and within recent years he has succeeded in convincing the leading authorities on the science of man's evolution that his finds are true remains of a people who lived before the Glacial Epoch. What is now most wanted is actual fossils of these

The fossil was described by Dr. Collyer as being "much heavier than a recent bone of the same size, it being infiltrated through its entirety with oxide of iron, and the surface presents peculiar metallic luster."

Whether it is as ancient as Dr. Collyer believed, or not, the emphatic point is that modern scientists are extremely anxious to recover it if possible. Dr. Henry Fairfield Osborn, President of the American Museum of Natural History (New York) has searched as far as he was able for this lost fossil.

It is hoped that when the search is given publicity the bone may come in, whether found tossed away in some out-of-the-way corner of some museum, tucked away on a dusty top shelf of some laboratory, or in some attic.

From the excellent reproduction of the fossil left us by Dr. Collyer (see cut) there would be no difficulty at all in deciding whether any similar fossil found were the particular one so anxiously sought.

Should you believe you had found this jawbone, do not permit it to be handled, but pack it most carefully and ship it to us or to any recognized authority on anthropology. —*American Journal of Physical Anthropology* (Washington, D. C.), vol. 7, pages 409-424 (Oct.-Dec., 1924). The bone was also described by Dr. Osborn in *Natural History* (Nov.-Dec., 1921).

Power Above Ground—Why Not Below Ground?

THE coal mining industry is beginning to dispense with the old-fashioned, inefficient man-muscle and mule-muscle methods of mining, transporting and preparing coal for use. The familiar pure food slogan, "Not touched by human hands," almost finds its modern counterpart in the working slogan of the up-to-date coal mine. Sometimes, it is true, hand tools are still used, but from the time the coal is first attacked with the recently developed electric mining machine until it reaches the surface, machinery supplies the muscle while man supplies the directing intelligence.

First, there is the mining machine, which undercuts the face of the coal seam. Formerly the miners crawled along on their sides and laboriously dug away the coal at the bottom of the seam; that is, they undercut it. This cut had to be wide enough for the entrance of the miner's pick, which he swung in a horizontal plane. When he had undercut as far back as he could reach and had also extended the cut sidewise a distance of several feet, holes were drilled into the upper part of the coal seam, an explosive was put into these holes and the coal was shot down, the shallow undercut permitting the coal to fall and to break up.

The mining machine which undercuts the coal far more rapidly and considerably deeper than the miner possibly can with his pick is really a sort of modified band saw. Mounted on a heavy truck is an electric driving motor which keeps the cutting bits biting into the coal, about fifty horsepower being required for this purpose. The sharpened bits are attached to an endless chain. The rest is simple: the endless chain keeps going around and around the pulleys, and as the coal is eaten away the whole machine pulls itself along sidewise by means of a winch and a wire rope.

Courtesy of the Goodman Manufacturing Company

The electric mining machine is shown moving through an entry of the mine to a working face. Note the bits on endless chain, in foreground

fundamentally it is an endless belt conveyor.

In a few mines having over six feet of headroom, power shovels somewhat resembling the familiar steam shovel in outline and principle are now being used. These power shovels are driven hydraulically and their scoop holds as much as 1,500 pounds of coal. Owing to the usual lack of overhead space for dumping the scoop into the mine car, some of these power shovels are equipped with a hydraulic pusher ram which simply pushes the scooped up load from the end of the scoop, much as one would discharge a spoonful of sticky food by pushing it off with another spoon.

A still more modern mining implement is the combined mining and loading machine. This is equipped with revolving heads which make circular cuts in the face of the coal seam, leaving hollow rings of coal which are easily wedged out without having to resort to the use of explosives. In this machine revolving buckets sweep the detached coal to a conveyor.

Although not over one and one-half percent of the total amount of bituminous coal mined in 1924 was loaded by machinery, even this fact is significant because this amount equals three or four times the amount similarly mined in 1923. It is also significant that this machinery is used in the mines which are managed by the most efficient, modern methods. Hence, other mines will soon follow suit. A great increase in machine mining is anticipated within the next few years.

At a number of mines where these labor-saving machines were used the output of coal per man has increased by as much as forty percent. Not only is mechanical mining and loading less costly, but it is altogether safer. Not a single fatal accident to a machine loading crew was reported in 1924.—*Coal Age* (New York), vol. 27, pages 67-70 (Jan. 15, 1925).

Courtesy of the Goodman Manufacturing Company

The cutter arm has sunk into the coal face behind the machine body and as it chews out the coal the entire machine is gradually drawn to the right by means of a winch

When the coal has been shot down with explosives it may be loaded in two ways: by hand shoveling, which is wasteful of human labor, or by means of loading machines. There are several types of loading machines, but they practically all operate on much the same principle as that of the ordinary above-ground loader such as, for example, the one you see loading coal from a pile to a delivery truck, or loading gravel into a concrete mixer. Naturally the machinery has to be heavier and stronger, and it is otherwise modified in many ways, yet fundamentally it is an endless belt conveyor.

The Duck You Hit Is Not the Only Duck You Kill

LEAD shot fired at wild ducks are the cause assigned for the death by lead poisoning of thousands of game birds which gain their food from the bottom of shallow swampy waters. Of the shots fired at birds from shotguns, only a few actually hit the game. The rest fall into the waters beneath and in course of time are swallowed by ducks, just as chickens swallow small pebbles for grinding up the food in their crops.

Ducks of some varieties, such as pintails and mallards, search for their food not merely on the bottom of shallow waters but they root up the bottom mud to a depth of from six to eighteen inches. In this manner they work over extensive areas quite thoroughly, and whatever hard objects of the desired size are met with by their bills, whether pebbles or shot, are swallowed. In the gizzard, which is an extremely powerful muscle, the shot are ground away little by little, the resulting fragments of lead slowly poisoning the ducks.

The symptoms of the poisoning due to this cause are quite similar to lead poisoning symptoms in the mammals, including, of course, man. Important muscles are paralyzed and the birds are soon unable either to stand or to fly. The wings droop from the sides and float loosely on the surface of the water. In many cases death comes in a few days. Sometimes it comes suddenly as a result of heart affection.

Alexander Wetmore, Assistant Biologist of the Department of Agriculture and author of Bulletin 793 of the Department of Agriculture, entitled, "Lead Poisoning in Waterfowl," has made a careful study of the lead poisoning of ducks by shot swallowing. He states that on washing out the matter contained in the gizzards and stomachs of ducks which have died of this malady he finds that there are usually from fifteen to forty lead pellets in them. Where the shot have long been in the bird's gizzards they are much worn and often ground down to thin discs.

Experiments made by Mr. Wetmore on ducks captured when young and reared in pens showed that only six pellets of number six shot constituted a dose of lead that was always fatal.

Generally duck shooting is done from certain spots in marshes, bays and lakes, these spots usually being chosen with a view to dryness, cover and other subtle considerations known only to those who love duck shooting. In time a great mass of pellets of lead accumulates in the mud bottom near these blinds.

Actual counts of these pellets were made near a blind that had been established for twenty years, the mud being shoveled up and washed through a sieve. The pellets first began to appear at a distance of about seventy yards from the blind and were found up to 150 yards. At 130 yards the pellets were most abundant and as many as twelve were found in each sieve filled with mud. On another marsh in Utah, 75,000 shotgun shells are fired each year and the resulting accumulation of lead amounts there to tons.

No practical suggestion has yet been proposed for combating this evil. Gravel has been especially supplied in some places, but to no avail, since it is a duck's nature to swallow pellets whenever they are met with by the bird's bill. Harrowing the bottom is useless, for the ducks penetrate the mud to depths of over one foot in search of food, while the harrow does not.

* * *

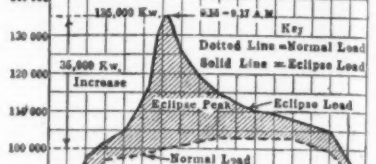
The Recent Eclipse and the Peak Load

LOOKED at from the point of view of the electric light and power industries the recent total eclipse of the sun was almost a total failure as a load builder. In most eastern cities the inhabitants were too busy looking at the eclipse to employ electric motor driven machinery until it was over.

New York and Buffalo were the only cities which showed an increase in power load during the eclipse, a fact which might possibly be interpreted in the light of the fear of a possible one-minute crime wave. To New Yorkers it was pointed out that bandits as well as scientists read the papers and that the former would probably try, unless checkmated by turning on the street lights, to take good advantage of the short period of night occasioned by the eclipse to stage a number of robberies. On this account the city lights were turned on in New York.

The Niagara Falls Power Company, supplying energy through wires to Buffalo and dozens of communities in the vicinity of the Falls, reported that there was practically no change in load during the minutes before, during and after the eclipse.

Smaller cities, such as Rochester, Elmira, Geneva and Poughkeepsie reported a decrease in power and light demand, to about sixty percent of normal load, the smaller the community the greater the decrease.—*Electrical World* (New York), vol. 85, pages 266-267 (Jan. 31, 1925).



COMPARISON OF ORDINARY SATURDAY MORNING LOAD OF BROOKLYN EDISON COMPANY WITH LOAD AT TIME OF ECLIPSE

Courtesy of the "Electrical World"

What the eclipse did to the electric power load in Brooklyn

Insects That Ride the Night Winds

THAT steady, rapid breezes in the upper atmosphere are most important factors in the surprisingly rapid spread of certain insects over the whole country is the belief of Dr. E. P. Felt, State Entomologist of New York (Albany, New York), whose department has been experimenting with small balloons in order to retrace the probable routes of insects which are carried long distances by air in very brief intervals. Purposive flight or migration of these insects thus becomes a secondary factor in their distribution over large areas.

In order for insects to drift long distances on the wind it is necessary for them to rise to considerable heights. Otherwise they would soon meet with some attraction or some obstruction and thus their flight would be greatly limited. The extensive balloon work conducted by the New York Conservation Commission during the past two seasons has shown that balloons inflated so that they have the least possible tendency to rise of their own buoyance may, nevertheless, be carried up by uprushing air currents such as, for example, those caused by the heating of the air over paved roads.

Once the balloons, and likewise the insects, are pushed up to a height of over one thousand feet they are usually carried many miles by breezes that nearly always blow at that height above the earth. Sometimes these breezes change to winds of a velocity of over one hundred miles per hour. At these elevations, where no obstructions to the forward flow of the wind exist, the movement is not necessarily very turbulent.

Courtesy of Dr. E. P. Felt

Monarch butterfly a worldwide wanderer on the wings of the wind

Certain it is that millions of Alabama cotton moths have turned up suddenly near open electric lights in our northeastern states and in Southern Canada, the specimens being in as perfect a condition as if they had just left the pupa. This does not suggest either prolonged migratory or purposeful flight, nor a considerable expenditure of energy. These insects, Dr. Felt believes, probably rose from the hot southern cotton fields on gentle upward currents and then drifted all through the night until they

dropped at electric lights in widely scattered northern villages.

Owing to the extreme cold the corn ear worm or corn borer cannot winter in any numbers north of the Ohio River and Southern Pennsylvania, yet occasionally it becomes extremely abundant in Southern Canada. It probably drifts with the south wind, somewhat rapidly.

Another wind-borne insect is the beautiful monarch butterfly. Although unable to survive the winter north of the sub-tropics, each season millions of individuals of this species reach Canada, even approaching almost as far north as the arctic circle. It is not so likely that these butterflies actually fly this distance purposely as that they are wafted on rapidly moving winds at comparatively high altitudes. These butterflies have even spread over a large part of the Pacific Ocean area, being found on some of the islands.

The cosmopolitan painted lady, Vanessa cardui, Linn., once appeared in May in Central Europe, having crossed the Alps from Africa. The ubiquitous mosquito, once it reaches a sufficient height above the earth, is probably carried over quite long distances. Unless thus unwillingly wafted aloft by upward moving air currents, the mosquito, like most other insects, prefers to seek shelter while the winds blow.

Grasshoppers have likewise been found at great elevations in the air, while it is thought that ballooning spiders may circumnavigate the globe in this manner, relying on steady air drift at comparatively high altitudes.—From a paper read by Dr. E. P. Felt at the recent annual meeting of the American Association for the Advancement of Science.

* * *

Buying Human Milk

IN Detroit, the production, collection and resale of human milk has been put on a commercial basis and is considered to have passed through the experimental stage of its development. There it is possible to purchase milk by the ounce, while a few infants whose parents are unable to pay for it get it free of charge.

The well-known *Journal of the American Medical Association* (Chicago) contains a description of this successful and laudable work, which could be imitated to good advantage in other communities. About a dozen years ago Dr. B. Raymond Hoobler of Detroit heard the well-known baby specialist, Dr. Holt, remark that human milk could be purchased through a private nursing home at the rate of fifteen dollars a quart. Yet, few people in ordinary circumstances could afford to pay such a rate.

Dr. Hoobler determined to find out whether mothers could be induced to produce and sell their milk for money. Through Miss Wadley of the Social Service Department of Bellevue Hospital, arrangements were made for regular milk production and sale on a strictly business basis. Since that time, the doctor states, several institutions have discarded the use of wetnurses and are securing breast milk from reliable mothers who deliver their product in sterile containers with the same regularity as any commercial milk producer.

The cost of producing includes the amount paid the mother, a flat rate of ten cents an ounce plus the cost of carfare for coming to the bureau. Most of the revenue of the bureau comes from private patients, as high as thirty cents an ounce being charged only when it involves no hardship. In cases in which the milk is needed and the parents are unable to pay the maximum price, the charge is scaled down to their paying ability. But in no case is a baby denied milk.

The bureau has a large clientele, and some mothers have raised as many as three consecutive babies on the milk furnished by it. "Many are the expressions of gratitude," says Dr. Hoobler, "by the mothers whose babies have been brought through a stormy nutritional period."

The milk producers are mostly got in touch with through advertisements in the daily press, although a few come to the bureau by reference. They must meet a rigid

standard, and the continued success of the institution would imply that this rigid standard has actually been met in the past.

Only healthy women, free from tuberculosis and showing a negative Wasserman reaction (no syphilis) are chosen. They must also have clean personal habits, live in a clean home, nurse their own healthy babies up to eight months, express milk at least twice daily, keep it on ice until delivered and supply at least sixteen ounces per day.

In this manner one mother earned nearly one thousand dollars during 1922. During three lactating periods extending over fourteen months another earned more than $3,500 and was thus enabled to purchase her own home.

No stipulation concerning the diet of the producer is made, but recommendation of a diet having a narrow protein ratio is made. An electric milker is being installed at the bureau in hopes of getting more milk from each producer.

The greatest percentage of infant mortality is among premature and sickly infants during the first one or two months of life, says Dr. Hoobler, and at present there seems to be no satisfactory substitute for breast milk at this early age, particularly if the infant is a weakling.

Why should this excellent work not be initiated in other communities?—*Journal of the American Medical Association* (Chicago), vol. 84, pages 165-166 (Jan. 17, 1925).

* * *

A Popular History of American Invention

ANY one who is familiar with the history of inventions will give the two volumes, a "Popular History of American Invention," which have just been brought out under the editorship of Mr. Waldemar Kaempffert, a high ranking among the literature on this subject.

Mr. Kaempffert was for many years the managing editor of the Scientific American, and during that period and in subsequent years he has become very favorably known as a writer of popular scientific literature. The work has been brought out in two volumes which contain altogether over 1,000 pages and 500 illustrations, notable among which are some excellent reproductions of photographs and portraits of our leading inventors.

The first volume is written under the three headings "Revolution of Transportation," "Communication" and "Power," and it contains a comprehensive survey of the development of the railroad from George Stephenson to our own times. Under the head of "Communication" is a review of the progress of the steamship on our inland waters; of electric traction; of the automobile and aviation. Particularly fascinating is the record of early achievements of such American pioneers as Langley and the Wright Brothers in this country, and Lilienthal, Maxim, Dumont, Bleriot and Farman in Europe.

The second volume, under the two main headings "Exploiting Material Resources" and "Automatic Labor Saving Devices," covers a very wide field, and emphasizes the leading inventions and work in iron, steel, copper, oil, coal, lumber, and agriculture. Other separate chapters cover "Automatic Machine Tools," "Putting Air to Work," and "The Manufacture of Clothing and Shoes by Machine."

Four of the chapters in these two volumes have been written by the editor, Mr. Kaempffert, and the authors of the other chapters are men of high standing in the world of science and mechanics. Although these volumes deal specifically with America, our great contribution is often so intimately interlocked with that of Great Britain and the Continent that this work should make a world-wide appeal.

¶ *Next month we begin another new department. Patent news and information for inventors. Don't miss even the first issue.*

Learning to Use Our Wings

Aircraft are being put to use in peace as well as in war. This department will keep our readers informed of the latest facts about airships and airplanes

Conducted by Alexander Klemin

Associate Professor of Aeronautics, New York University

An American Amphibian

AMERICAN aviation awaits with interest full details of the new Loening Amphibian. Its performance and construction have been so far kept a secret by the U. S. Air Service, but somehow a photograph and brief description made their appearance in the Spanish paper Alas! The photograph supplied by the Loening Aeronautical Engineering Corporation discloses some striking novelties. Vision is all important to a military or naval pilot, and when a great Liberty motor is placed ahead of him, his "blind angle" certainly is not improved. The designer has met this difficulty here by the simple yet novel expedient of inverting the motor, with cylinders below and the comparatively inconspicuous crank-case above.

Loening Aeronautical Engineering Corp.

The Loening Amphibian as a land plane. The wheels are down and give as solid a support as in any ordinary landing gear. A small tail skid is seen at the end of the hull proper on which the fuselage rests solidly

With only a few changes in the oiling system, the inverted Liberty works if anything better than in its normal position, and it is far more accessible to the mechanic for adjustments. To facilitate mooring at a dock, it has been customary in flying boats to place pilots and passengers ahead of the motor, with the propeller behind the motor acting as a "pusher." In this design the menace of the heavy engine above the occupants has been removed, by using a "tractor" combination, and docking is apparently just as easy.

Loening Aeronautical Engineering Corp.

Now that the wheels have been drawn up into the sides of the hull the Amphibian is ready to do duty as a seaplane. This dual capacity of the Amphibian adds immensely to its value and versatility

Departure from a Chinese form of tradition is necessary even in the comparatively new aeronautical industry! The fuselage sits solidly on top of the short flying boat hull, and by a simple electrical motor control the wheels swing up and in towards the hull, thereby a dual, amphibian function is given to the airplane. The faculty of alighting on either land or water will be invaluable to the Air Service in patroling the Philippine Islands, but it is just as important for commercial flying. An amphibian can fly safely over land, with the landing carriage retracted but ready for instant use. It can also alight in the heart of a city, using a river instead of a distant flying field. And apparently modern design can meet the handicap of extra weight and complication of the retractable gear without allowing the performance in speed and climb to suffer.

* * *

High Speed Diving

WHEN Captain Skeel perished in his fatal dive at the Dayton air meet how fast was he traveling? It is sometimes imagined that if an aviator dives vertically downwards and starts from a great enough height, there is no limit to the speed which he can attain. Nothing could be more erroneous. When the pilot does dive vertically, the wings may indeed give no lift, but as the speed of the dive increases so does the drag or resistance of the airplane. Finally they will equal one another. The plane will then travel downwards at tremendous speed, but it will *not* accelerate; it has reached its limiting diving speed.

What does this limiting speed depend upon? The weight of the airplane and the "cleanness" of its design. The heavier it is for a given area of wing, the greater the limiting speed. And the cleaner it is, the less the resistance for a given speed, and, therefore, the greater the speed at which resistance finally balances weight.

No pilot likes to reach the limiting speed of the dive, and it is doubtful if air-speed meters have yet been built which will measure the limit of speed on a dive for modern racers. But calculations are possible with a fair degree of accuracy. If a racer has a maximum speed of 250 miles an hour, then

its limiting diving speed will be in the neighborhood of 350 miles per hour, with engine dead and the propeller not turning. If the engine is dead and the propeller is turning over slowly, the limit will be some few miles less. These low values (comparatively speaking) are due to the fact that the propeller is now exercising a powerful braking effect. But, if the aviator were bent on committing suicide, he would let out his engine so that the propeller was still giving some thrust although working under unfavorable conditions. He could then work up the comfortable speed of some 450 miles per hour! The dangers of engine power on during the dive are two-fold: failure of the wings on pulling out of the dive; failure of the propeller due to excessive speed of revolution. We doubt whether any man lives that can report 450 miles per hour!

Scientific Crashes

AIRPLANE accidents there always will be, though their number is constantly decreasing. The question is, in a bad crash, what is the type of construction which will allow the pilot to escape even if the plane is wrecked beyond repair? Army Air Service officers are making a scientific investigation of the subject. Four old planes with four old motors are being used. The planes stripped of their wings are placed on an inclined skidway some 100 yards in length. With the motors developing their full power, the thrust of the propellers and the effect of gravity combine to hurl the plane down the skidway at terrific speed—to meet a rigid concrete wall at the end of the run!

International News Reel

To determine if its 100 gallons of gasoline would explode in a collision an army airplane was sent crashing into a wall at the rate of 100 miles an hour. There was no explosion. Our photograph shows the instant the plane struck

Our photograph shows the result of one of these tests at Wilbur Wright Field, Dayton, Ohio. The plane was smashed to bits, but the gasoline system did not explode. In other tests the gas did catch fire with a terrific explosion as a result. Comparative analysis of such tests may do much to rob crashes of their terror.

The Human Machine in Aviation

AVIATION presses into its service every branch of engineering. It has also set a great many problems for medicine to solve. Our pursuit planes and even our racing planes have by no means reached the limit of speed. But, have they perhaps reached the limit of maneuverability? An Air Service pilot, Lieutenant Doolitle, has produced accelerometer records showing a centrifugal force 7.9 times gravity in a series of violent maneuvers. In other words, if the gallant officer weighed the 180 pounds which pilots are supposed generally to weigh, he would have been pressed against his seat with a force of over 3,200 pounds, more than a ton and a half! Can brain or heart possibly stand anything more than this? Will our combat pilots have to undergo a special course of training to withstand these abnormal physiological demands?

This is but one of the many problems the Air Service is asking its surgeons, physiologists and psychologists to answer. The Army circular on "Air Medical Service" makes fascinating reading. How is it that skilled and daring pilots have been seen to dive or "vrille" a thousand feet or more to their death without making an attempt to right their planes? Professor Dockery, a psychologist trained in the art of flying gives us a vivid answer: "It is believed that the experience of the sudden plunge of a plane in an unexpected direction is something no one can appreciate except those who have had the experience. The flyer does not merely lose his balance at such a time. He has changed his position with reference to the earth by several hundred feet in a few seconds. The rush of air, the abnormal pressure upon his viscera, and the loss of the direction of gravity are capable of creating all the conditions of a violent emotion, which, if not checked quickly, becomes worse, and the aviator may lose all consciousness." Fortunately, atmospheric conditions producing such accidents are rare; it requires the combination of a bright, hot day and particularly disturbed territory to produce bumps that really trouble the aviator. But pilots should have the peculiar physical make-up necessary to withstand such conditions.

How does the aviator react to lack of oxygen at great altitude? At what altitude will he cease to act intelligently? Is he of the fainting or non-fainting type? The flyer is tested in a special low-pressure chamber by the School of Aviation Medicine as scientifically and impersonally as a chemical substance in the analytical laboratory.

During the war a pilot was compelled to be continually on the alert looking up and down, to right and left, and before and behind him. The muscular movement required by this constant turning and twisting is so great as to cause in some, after a few months, an enlargement of the neck. It follows that if the neck muscles are so exercised, the six muscles that move the eyeball must likewise work harder than usual. Rapid control of the eye muscles becomes a most important matter particularly in judging distance during a landing.

There is no doubt that anyone can learn to fly. But the true airman must evidently have inherent qualities, that can be developed but not created, and the work of the Medical Air Service in finding these qualities and in testing men scientifically to ascertain their possession has an unsurpassed interest and importance.

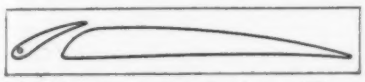
Slow Landing

THE Tenth Annual report of the National Advisory Committee for Aeronautics emphasizes one of the outstanding problems of the airplane, that of slow landing.

No matter how safe it may appear to the

skilled pilot to approach the ground at the speed of an express train, the public would prefer a gentler and slower approach. To attain this an indefinite increase in wing area is impractical, since dimensions then become clumsily great and high speed is cut down. Variable area has been attempted several times, but mechanical complications have hindered its adoption. Variable camber has so far failed of success for the same reason. The report suggests that rear wing flaps and wing slots are the most promising method of attaining low speed.

Rear wing flaps have already been used with satisfaction on a great many light planes in England, and may be counted upon to increase the maximum lift twenty-five percent or to decrease the landing speed some ten or eleven percent accordingly.



Handley Page slotted wing. When the slot is closed, the wing behaves like an ordinary aerofoil. When the slot is open, the maximum lift is increased, facilitating slow landing

The famous Handley Page slotted wing, shown diagrammatically in our sketch, when open actually increases the maximum lift between fifty and seventy percent! Its incorporation involves many mechanical difficulties, and aeronautical engineers always like to leave their wings free of all "gadgets" or complications. Nevertheless, this tremendous increase in lift may very well be utilized one day either to diminish landing speeds or to increase the carrying capacity of our planes.

Metal Construction to Stay

REGARDING the use of the Handley Page slot, there is room for controversy. But there is no controversy possible regarding the advantages of metal construction, also discussed in the Tenth Annual Report of the National Advisory Committee for Aeronautics. Progress in the use of metal has been retarded by the high cost of experimental work in such material. But as a technical problem, the substitution of metal for wood in airplane construction may be reckoned as a definite achievement. Landing gear and tail surfaces are almost invariably built of metal. Fuselages or bodies are rapidly following in the same direction.

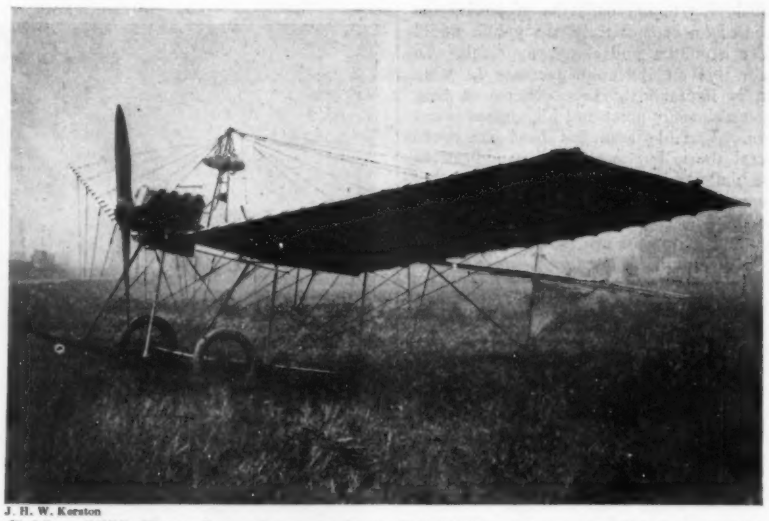
In most recent designs of fuselages a framework of mild steel tubing is used with a covering of fabric. There is much variation in the details of the fuselage frames. Some designers use wires for their diagonal braces, some use tubes throughout. Some make their joints by welding, others by fittings which are pinned and sweated in position. One of the surprising things is the bold dependence now being placed on welded joints. Welding is now used even in tension members, where its use would have been prohibited a few years ago.

The economical production of welded tube fuselage, the comparitive merits of acetylene and electric welding offer a profitable field of investigation for shop men and metallurgists alike. Fuselages of steel tube are not only more durable than the old stick and wire construction but offer better protection in case of a crash. The photograph shows a metal fuselage now being built for the Army Air Service by the Atlantic Aircraft Corporation with which the famous Dutch designer Fokker is closely connected.

Marking Roofs

CROSS-COUNTRY flying is a simple matter under auspicious circumstances, and strip maps indicating railroads, water-towers, unusual buildings and other landmarks are a great help. But even the best of maps in a region abounding with landmarks may confuse the pilot.

Major Lloyd T. Jones writing in *United States Air Services* suggests that marking village roofs with the village name is the simplest and most reliable aid aircraft could possibly have—besides constituting a "boost" for the village itself.



J. H. W. Kerston

Fokker 1911 Monoplane shown at Paris Exhibition, December, 1924. Speed, forty miles per hour, sixty horsepower

A Study in Progress

THE little monoplane illustrated here was built by Anthony H. G. Fokker, famous Dutch airplane constructor in 1911. A modern plane built by the same man is also illustrated. The difference is striking.

The maze of wires in the early plane has disappeared, the necessary strength being now given by internal bracing in a much thicker wing. The engine and tank are now housed in the fuselage, instead of being exposed to the air. The occupants are now sheltered instead of being exposed to the cold blast from the propeller. The factor of safety on the early planes averaged four or five, now a weight of ten times the whole weight of the airplane may be distributed over the wings before failure takes place.

J. H. W. Kerston

Fokker 1924 D13 type pursuit plane shown at the Paris Exhibition, December, 1924. Speed, 172 miles per hour, 460 horsepower

Metal Floats

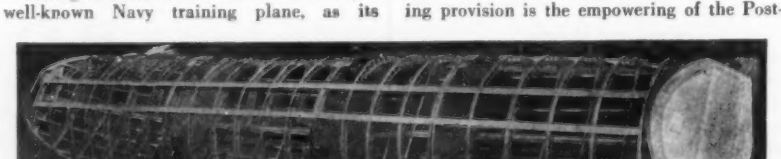
THE Navy is seeking to eliminate wood, not only in the construction of the hulls of its huge flying boats, but also in the floats of its smaller hydroairplanes. Commander H. C. Richardson in the *Society of Automotive Engineers Journal* describes a systematic and exhaustive development of metal floats made by the Navy.

Taking the standard float of the N-9, a well-known Navy training plane, as its wooden model, and keeping the same water lines and displacement, the Navy tried out nine different forms of construction, using the experience of Dornier, Zeppelin and Junkers for some of the experimental designs, and turning to American talent with the cooperation of such firms as the Curtiss, Glenn Martin and Aeromarine companies. The standard wooden hull weighed 293 pounds, dry. Soaked with water it weighed 340 pounds. The metal float with identical outside form weighed only 227 pounds, and water soakage was entirely avoided.

There is but one drawback to the use of metal floats, and that is price. A wooden float can be easily and rapidly built by a skilled boatmaker, working with spruce and veneer. Its cost averages $900. The metal float with its specially formed parts, and the enormous number of rivets necessary to secure watertightness runs close to $7,000.

Commercial Jottings

THE Air Mail Act has passed the House. It may pass the Senate. The Act calls for an extension of the Air Mail to the New England States, which quite rightly are anxious to secure air facilities as soon as possible. But a more important and far-reaching provision is the empowering of the Post-



Society of Automotive Engineers

A type of metal float replacing the wooden floats formerly used in navy hydroairplanes. At C is shown one of the lightened transverse bulkheads. At A and B, reinforcements for receiving the struts which run from the float to the fuselage or body of the plane

master General to place contracts for the carrying of air mail by private companies, just as privately owned railways lease their facilities to the Post Office department now. The private company could carry passengers and freight with mail as a steady source of primary income, and nothing could give prospective investors in an air line more confidence than this, or stimulate commercial aviation to better advantage.

Missouri is as interested in Air Mail as is New England. Its three large cities, St. Louis, St. Joseph and Kansas City, are making a great effort to have the Chicago-Omaha airway diverted through their boundaries, with but little extra mileage and a chance of some very profitable business for the Post Office department.

Another instance of the universal interest in aviation is the fact that Wichita, Kansas, is not waiting for the House Committee's Report on the Operations of the Air Services to inaugurate a policy of government landing fields, but is pitching right in, with a company formed by prominent citizens of the town, to purchase and operate an air terminal on a regular commercial basis. Nothing is more gratifying than such instances of individual effort.

Man Hours

HOW long does it take to build an airplane? In automobile construction production men know the time it takes to turn out every little detail. Aircraft construction is still largely experimental, and records of labor and cost are scarce. Therefore, it is very interesting to read in *Aviation* the record of time spent in building a small three-place metal-hull flying boat, with a seventy horsepower Anzani engine by the Aeromarine Company. It took 2,375 hours to design it, and 6,360 hours to build it, the hull being responsible for more than a third of the entire effort.

Prophecy

C. G. GREY of the *London Aeroplane* is one of the most colorful personalities in aviation the world over. He fought bitterly in England for a United Air Service and after a visit to the United States advocates the same union of the Air Services here. We are more interested in his suggestions of a less controversial character. Writing in *Aviation*, he advocates the building of fool-proof ships for commercial service, and gives an outline specification of what is possible at the present day, without any great departure from conventional practice.

The passenger airplane must be able to fly at as low a speed as forty-five miles per hour without losing height and with full control. If it should stall, that is, go beyond the maximum flying angle, it must still remain in control, and not dive violently to the ground. And finally, it must be capable of a landing speed of twenty-five miles per hour and a drop from twenty or thirty feet without damage being done. For cross-country flying over reasonably good territory, a single-engined ship is permissible. But for flying over broken country or over the sea, Mr. Grey rightly advocates the use of three engines, in which one engine could go out of commission at a moment's notice without the slightest hazard of a forced landing.

After voicing admiration of our Air Mail, a model for the world, Mr. Grey hazards this prediction. "Our air lines today are funny. Even that wonderful New York-San Francisco Air Mail line is funny, if one puts oneself some ten years ahead, when the New York terminal is on the roof of the Pennsylvania Station, instead of in a little wooden hut in the middle of Long Island, and when special mail-ships do 200 miles an hour guided and warned of fog by directional radio instead of old war-junk doing a paltry 100 miles an hour guided by acetylene flicker-lights and mere common electric searchlights."

¶ *Coal is now burned from jets, just as gas is. This important new development is described in next month's Scientific American.*

Radio Notes

A Review and Commentary on the Progress in This Branch of Rapid Communication

Conducted by Austin C. Lescarboura

Wiring the Home for Radio

RADIO has now reached that state in its development where the home must be wired for it. That is to say, the latest idea is to wire the home with special outlets in the various rooms so that the radio program may be enjoyed in any part of the house.

A variation of this idea has been worked out in a New York City apartment house colony. The 354 apartment owners of this colony need merely push a plug into a wall plate and listen in. The wall plate is provided with four jacks, so that there is a choice of four programs. Three of the four programs are local, while the fourth is a DX feature or special program furnished upon request. On the roof of the apartment house colony is the operating room, with four loop receiving sets of the finest type. An operator takes care of the four receiving sets, while the outputs from these sets are passed through power amplifiers and sent over the wiring to the 354 apartments.

How About a Tax on Vacuum Tubes?

THE recent contest of the American Radio Association for the best solution of the great question, "Who is to pay for broadcasting and how?" has been won by H. D. Kellogg, Jr., of Haverford, Pa., who received $500 for his successful efforts.

The winning plan calls for the public to pay for broadcasting by means of a tax on each vacuum tube and crystal bought by the consumer for his radio set. It is pointed out that radio broadcasting, to be placed on a sound, economic basis, must pay its way as do other forms of entertainment; that to secure the best that radio can offer calls for broadcasting to be put on a paid, contract basis. It was further pointed out that tubes have a life commensurate with the service they render, which makes them an index to "broadcast consumption." Furthermore, the number of tubes was considered to be an excellent index of the cost of the set and the range over which it will receive; and that, since the manufacture of tubes is so nearly a monopoly, a consistent check-up of the tubes purchased could be had.

It is suggested that the tax money collected be deposited with the government and that a newly created Bureau of Broadcasting administer the fund. Stamps purchased by tube manufacturers from the Bureau of Broadcasting would be affixed by the manufacturer to the tubes, the amount of tax to be paid to be determined from statistics compiled by this bureau.

Mr. Kellogg's plan, while cleverly worked out and deserving of the $500 prize, nevertheless, does not receive the endorsement of the American Radio Association.

Wide World

Dr. Charles V. Paterno has solved the radio problem for tenants. A radio operator on the roof of his newest apartment building does the tuning for the house and all that it is necessary for any occupant of the apartments to do is to plug in to the station they wish to hear

Better Vacuum Tubes at Lower Cost

CERTAINLY the best news we have this month is the drop of another dollar in the list price of vacuum tubes. From four dollars to three dollars, list! What a contrast with the prices of not so long ago! We remember when vacuum tubes were bringing eight dollars each, and even at that price it was a struggle to get them. With the new list price, the item of tubes no longer looms so big even when contemplating the installation and operation of a multi-tube receiver.

The lowered list price of standard tubes will prove a heavy blow to the makers and vendors of the so-called "bootleg" tubes, which have been so conspicuous during the past year. The price of standard tubes is now so low that one can hardly afford to "take a chance" on a "bootleg" tube.

Our grievance in this respect is not with makers and vendors of vacuum tubes which are plainly marked with the manufacturer's name. Rather, it is directed against the counterfeit tubes, which have been labeled with counterfeit seals and packed in counterfeit cartons, and bought by persons who firmly believed they were getting the genuine article.

Who Does the Squealing?

WHENEVER the subject of squealing or radio radiation has come up for comment, the regenerative receiver has come in for some very uncomplimentary remarks. In fact, that receiver has been blamed for all the noises of the air.

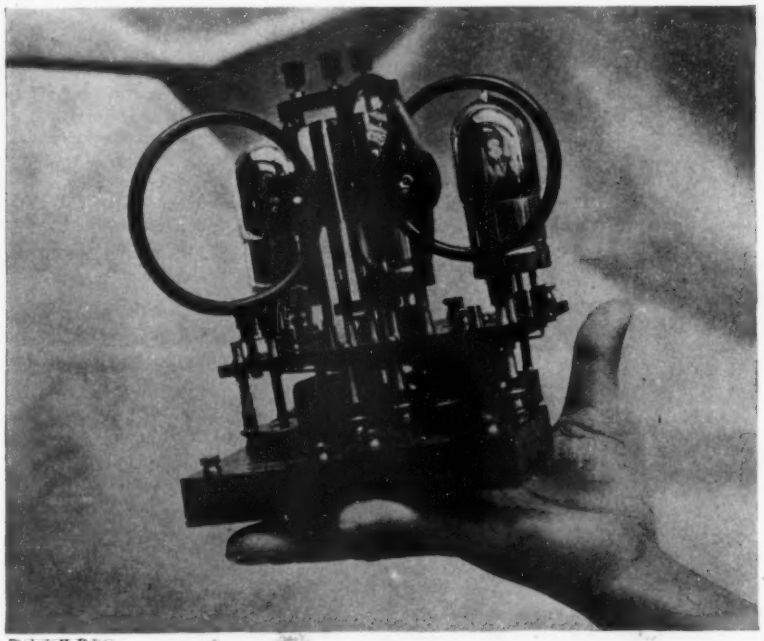
Yet it now appears that the regenerative receiver is not altogether at fault. Other sets in extensive use are also capable of

oscillating and squealing on their own account. During the recent transatlantic tests a large number of super-heterodyne receivers were connected with antennas by their ambitious owners, and their steadily oscillating tubes were allowed to play a merry tune in their respective vicinities.

Radio-frequency receivers are not always free from squeals. Even neutrodynes which have become unbalanced or never were properly balanced or neutralized, become squealers.

It behooves each and every radio enthusiast to do his utmost to banish radio squealers. If you have a neutrodyne which is tuned by the squeal, it is no longer a neutrodyne. Have a radio expert neutralize it for you, for the sake of better results for yourself, as well as for the good of radio broadcasting in general. If you have a super-heterodyne, do not use it in connection with a large antenna. Be satisfied with a loop or, if you must use an antenna, with a very small one. If you have a radio-frequency receiver with a potentiometer to prevent oscillations, be sure you operate the potentiometer properly to prevent squeals.

If you have a tricky regenerative receiver of the single-circuit type which attempts to do miracles with a single tube, take it out in the back woods miles from any other receiving set. Then use it to your heart's content. If you have a coupled regenerative receiver, learn how to run it so that you will not push the regenerative action to the point where the detector tube oscillates or sets up a howl to disturb your neighbors. Properly adjusted for regeneration, the regenerative receiver should give a swishing or rustling sound as the set is tuned across a carrier wave, instead of a squeal or whistle. If you know that your receiver has a tendency to oscillate, then build or buy a one-stage radio-frequency amplifier which will serve to increase your range while at the same time avoiding radiation.



Frederic M. Delano

A three-tube receiving set which can be held in one hand. The coils are wound in ring form. Spiderweb coils can be inserted for distance work, all the coils being interchangeable

The Passing of the "Soft" Tube

THERE was a time not so long ago when no set was considered efficient unless it had a "soft" tube for the detector. Today, however, the "soft" detector tube is practically a thing of the past. Instead, we use "hard" tubes or what are really amplifier tubes.

The reason why the "soft" tube has become obsolete is not hard to find. This tube requires a most delicate adjustment of the filament and plate voltages if it is to operate at its maximum efficiency. Prior to the development of radio-frequency amplification, it was necessary to squeeze the last bit of sensitivity out of the "soft" detector tube, and it was worth no end of bother with vernier rheostat and tapped "B" battery to gain this end. The plate voltage might be some specific value anywhere from 16½ to 30 volts, depending on the characteristics of the tube. The filament voltage had to be adjusted to the precise point of maximum efficiency by means of a vernier rheostat. These adjustments were carried out while receiving the weakest DX signals; and to make matters still worse, the adjustments would hold for just so long, when the characteristics of the tube would change, the batteries would become weaker, and so on.

The development of radio-frequency amplification which builds up signal strength so that the detector need no longer be as sensitive as formerly to intercept the weakest signals, together with the demand on the part of the public for the simplest kind of manipulation, has led to the universal use of the "hard" or amplifier tube. Such a tube is not critical in its voltage requirements. The plate voltage may run anywhere from 22½ to 45 volts without material difference, while the filament voltage may be anything between five and six volts.

There is no hissing noise when using the "hard" tube, as compared with the noises caused by the "soft" tube. The rheostat control need be of the simplest kind for "hard" tubes.

Radio for the Entombed Miner

EXPERIMENTAL work designed to test the availability of radio as a means of communication between miners entombed following mine fires and disasters, and rescuing parties on the surface, conducted by the Department of the Interior at the Pittsburgh experiment station of the Bureau of Mines, indicates that ordinary radio apparatus would not be practicable for the purpose. There is some promise, however, in the application of "wired wireless" or line radio, which, under mine conditions, means transmission along metallic conductors such as water pipes, compressed air pipes, power and lighting circuits, and mine-car tracks; and the use of ground-current methods of signalling.

Because of the higher conductivity and resultant attenuation of the high-frequency radio waves in penetrating the earth, relatively high power equipment, which means bulk and weight, would be required for mine rescue purposes. For reliable communication by pure radio over distances of even 1,000 to 2,000 feet through strata, transmitting equipment with an input of from 50 to 200 watts or more, and used in conjunction with a sensitive receiver, would be required.

Such equipment would be much too bulky, heavy, and complicated to fulfill the requirements for practical mine apparatus.

Static Is Directional

FROM no less an authority than Dr. L. W. Austin of the United States Bureau of Standards, comes confirmation of the familiar idea that atmospheric disturbances or static on the Pacific Coast are directional in character. This theory is backed up by convincing proof obtained from a long series of experiments conducted last summer near San Diego, California.

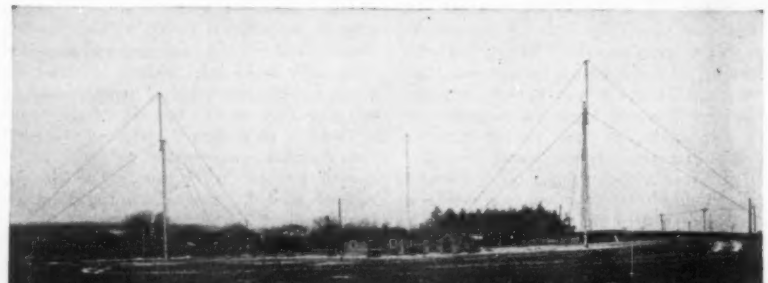
By means of a coil antenna or loop, affording uni-directional reception, it was found possible to maintain uninterrupted daylight reception of radio signals during the height of the static season on the Pacific Coast, from the transmitting station at Cavite, Philippine Islands, and from the Dutch transmitting station at Malavar, Java.

The 100-Kilowatt Station of WGY

STEEL towers and wooden masts interconnected by a maze of wires are now making their appearance near Schenectady in connection with the giant radio transmitting laboratory of station WGY. There is to be a wide assortment of aerials, together with various buildings containing all kinds of transmitters, all for the purpose of solving some of the present and future problems of radio transmission.

The 56-acre laboratory is located six miles south of Schenectady. In this laboratory the engineer will endeavor to find means of improving transmission quality and reliability, and he will test theories of static and fading in the hope that these twin terrors of radio listeners may be banished.

The aerial structures include three towers 300 feet high arranged in the form of a triangle. From these steel masts almost any type of aerial may be strung for operation on wavelengths of from 600 to 3,000 meters.



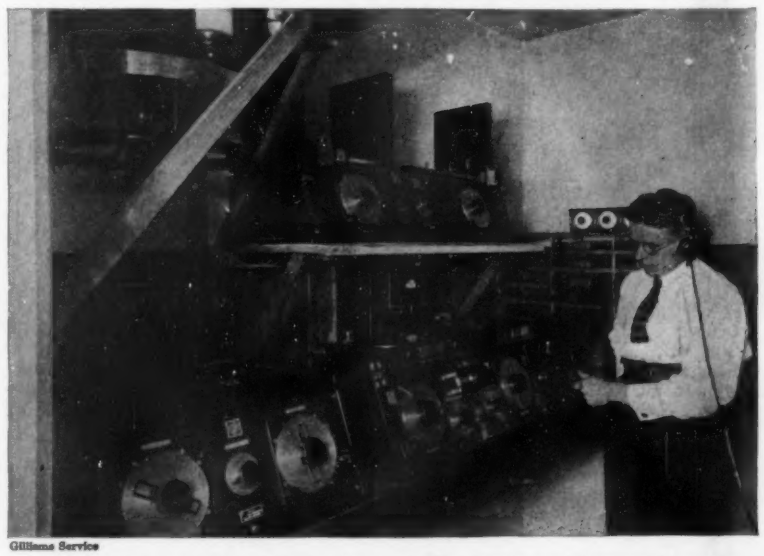
General Electric Co.

Antenna system for experimentation on 100 meters wavelength transmission at 56-acre laboratory of the General Electric Company near Schenectady

New Types of Variable Condensers

THE agitation for low-loss condensers has caused the designers of radio apparatus to attempt several radical departures in condenser architecture. One of these radical departures is a variable condenser with both sets of plates made movable. As a result, it is claimed that the condenser action can be reduced to a quarter turn instead of the regulation half turn. This makes it possible to bring flexible leads from both sets of plates, without the usual mechanical difficulties. In addition, the plates can be made small and can be soldered together at one point on their outer edge, and also at the shafts. Each set of plates is mounted on a shaft provided with a bakelite gear. The two gears are meshed with a small brass pinion which in turn is connected with the dial.

Another exponent of the old sliding-plate condenser has tapered plates, for the purpose of giving a square-jaw curve and lowest minimum capacity. Negligible loss is obtained with the use of hard rubber insulating strips of long leakage paths placed in the weakest part of the electrostatic field. Its small size, ruggedness, and single-hole mounting make this condenser highly desirable for the radio builder.



Gilliams Service

A part of the apparatus in the giant wireless station at Nauen, Germany, where radio messages are sent to and received from this country. This photograph shows one of the rooms for the reception of messages

Another radical departure in condenser design makes use of the old sliding-plate principle, but on a much improved basis. The sliding member is pulled in and out by means of a stem which makes its complete stroke if the dial is turned ten complete revolutions. This means that the scale is 3,600 degrees long. By pushing the small pin at the end of the stem it is possible to set quickly to the right tenth of the range.

A fourth steel tower, 150 feet high, may be connected to any of the trio of masts for work on wavelengths of from 200 to 600 meters. In addition to the steel towers, there are numerous wooden masts for aerial systems for experimental work on short wavelengths—15 to 200 meters.

Static Forecasts a Possibility

FOR some time back there has been an ever-growing desire on the part of broadcasting folks—broadcasters as well as audience—to have the Weather Bureau forecast radio reception conditions just as it does the weather. The Weather Bureau officials have made no official investigation of static and its relation to weather conditions, because of lack of the necessary funds and personnel. Nevertheless, some study of the subject has been undertaken in a purely unofficial way.

"We fully appreciate that such forecasts would be popular and well received," states an official of the Weather Bureau. "Several of our people interested in radio in a personal way have been making notes on radio reception under varying weather conditions. These fragmentary reports and experiences lead us to believe that radio weather forecasts, for at least a day or two in advance, may be practicable. However, we feel that it would be unwise to attempt a new work of this sort in a hit-or-miss way and that it should not be begun until the subject has been studied thoroughly and systematically, and we are convinced that reliable service can be given.

"This Bureau has not undertaken any investigation of the problem officially. The difficulty is that we have no funds which can be applied to the providing of facilities and personnel for the conduct of the investigation. There are so many factors involved that it would require an extensive program of collecting and compiling data before a serious study of the problem could be made."

Let us hope that some day our Weather Bureau will issue static forecasts. It would be a boon to the broadcasters in arranging for feature programs. And it would be a boon, even if a smaller one, for broadcast listeners to know whether to have that radio party tomorrow night or the following night.

Courtesy of Crosley Company

The newly developed microphone does away with the "one moment please" wait between numbers. Two signs, "Prepare" and "Broadcast" are illuminated as required and there is no loss of time between numbers

Antenna Masts

WHILE the usual practice is to support the receiving antenna with any convenient objects, such as the house, the barn, a nearby tree and so on, it is a fact that such practice is not always conducive to the best results. If the antenna is strung too close to surrounding objects that by their very nature tend to absorb the radio energy, it stands to reason that the feeble impulses from distant stations will never reach the receiving set.

To those who seek the very best reception facilities, the solution is to be found in the use of masts for supporting the antenna. If a tall house is available for one end of the antenna, then only one mast is required for the other end. There are now available steel masts in sizes to get 20, 40 and 60-foot clearance. These masts are of such design that they may be erected in a few minutes' time.

A Receiver Which Clips to the Ear

A NEW type of headphone does away with the usual head band. In its stead it provides each receiver with a simple wire loop which clips the light receiver unit to the listener's ear. A novel design for the telephone unit has greatly reduced the weight of the individual receiver, making this method of wearing it quite feasible.

The Counterpoise Ground

IN most localities the ground connection involves no more effort than running a lead to a nearby water pipe and making a good contact by means of a ground clamp. However, in other localities, fortunately few and far between, a ground is not as simple as that. Especially is this true in sandy soil or rocky soil, where the absence of moisture in the ground makes for poor radio conductivity. In such localities the counterpoise type of ground should be employed. This consists of a number of wires carefully insulated and supported above the ground by a foot or two. The counterpoise ground will give good results for reception.

Still another use for radio. Captain of the first radio equipped tug boat receives his orders from the ether

Still Less Ship Interference

A PROMISE of a future day when our broadcasting will not be marred by the signals of ship transmitters, is offered in the recent report of Dr. Alfred N. Goldsmith, the well-known radio engineer, presented before the conference of the Radio Section of the Associated Manufacturers of Electrical Supplies.

During the year 1924 there was an increased use of continuous-wave transmitters and vacuum tube receiving apparatus aboard ships, making for less and less interference with broadcasting. "The trend toward continuous-wave operation," states Dr. Goldsmith's report, "is also evidenced in the marine service shore stations. This has been particularly stimulated by the interference caused by such stations with broadcast reception and the resulting dissatisfaction to large groups of broadcast listeners. Congestion of marine traffic has been considerably relieved by the use of the longer wavelengths (1,578 to 2,499 meters) with continuous-wave operation from tube or arc transmitters. Not only is traffic thus taken off the crowded shorter wavelengths, but the mode of transmission is such as to reduce interference in the marine service as well as in the neighboring broadcasting stations.

"The exact ship and shore station wavelengths on the east and west coasts of the United States are still under consideration, it being planned to work out a system of staggered wavelengths for the shore stations, such that interference between them and the ships will be largely avoided, and also establish wavelength bands for ship spark operation, and other bands for ship continuous-wave operation exclusively."

Reducing Receiving Set Noises

WHEN using two stages of audio-frequency amplification it is by no means uncommon to experience disagreeable noises, as well as plenty of distortion. This is particularly true when two transformers of high ratio are employed.

Radio experimenters have worked out three ways of reducing the noises and still have excellent amplification with fair quality. The first is by shunting the primary of the second stage transformer with a fixed condenser or resistance, the capacity or resistance being governed by the ratio of the transformer. If two transformers having a ratio of five to one are used, the correct capacity will be about .001 mfd.

The second method is by shunting the secondary of the second stage transformer by a high resistance, the correct value again being determined by the ratio.

The third method of reducing the noises is the same as the second, only a small condenser is used in place of a resistance. The latter method is, however, not the best, as it tends to reduce the volume of the overtones, which are essential for good reproduction.

The above outlined methods of reducing noises in an amplifier will also abolish the disagreeable whistle known as an audio-frequency squeal.

This huge loudspeaker was used at the Berlin radio exposition where it conveyed radio programs to every person in the great building which was erected solely for this exhibit

Science and Money

A New Department for Investors

Conducted by E. E. Free

IT is commonly supposed that no scientific man knows anything about money or has any business to have any. The be-whiskered professor, starving in his cob-webby laboratory while millionaires are busy making money outside, is a familiar figure in all forms of fiction from the comic supplements to newspaper editorials.

No idea could be more quaintly untrue. It is a fact that some scientists are poor, a condition not unknown among members of many other professions. But it is also a fact that most of the wealth possessed by the world today has been created by the scientists. The title of this department is no misnomer and it is proper that science come first. Without science there would be no money.

Nor do I mean by money merely the counters of gold or silver or printed paper that we carry about in our pockets. I mean every token and embodiment of wealth; the house we live in, the clothes we wear, the factories we own or work for, the shares or other securities which represent invested capital and income-producing wealth. These things could not exist at all were it not for science. Imagine factories without engines, houses without bricks or iron or mortar or cement, public utility bonds without gas or electricity.

The basis of modern wealth is applied science. This fact is one of the things so commonplace that it is frequently forgotten.

This Department

ONE purpose of this department is to keep you from forgetting this fact. Another purpose is to offer what we believe may be an additional kind of helpfulness to our readers.

There are many existing agencies through which any reputable inquirer can obtain ordinary financial information. If you wish to know the earnings of a certain stock, the detailed assets back of a certain bond issue, you can get this information from any one of a dozen magazines or books. Your banker is competent and ready to advise. There are able statistical organizations prepared to serve you promptly and well.

But suppose you want some information about the real, ultimate, fundamental basis of an industry. Suppose you want to know the engineering facts, the scientific facts that underly the prospective value of some investment. Do you know where to go for these?

That is our job. We have been doing it for years for those of our readers who have acquired the habit of writing to us. We are going to do it, more definitely still, in this department. It will be the purpose of these two or three columns each month to tell the investor what important scientific developments have occurred or are impending and which seem likely to affect financial matters.

Atomic Power?

FOR example, there is the matter of atomic power. We have received many letters in the last few weeks asking us whether the recent discoveries about atoms mean that power will soon be made from this source, so that investments in the securities of power-producing companies are likely to be jeopardized.

To the man who believes that nothing ever changes, this may seem a foolish question. How could a tiny atom upset the electric business? But the question is not foolish and an atom may upset the electric business some day—indeed, the chances are that it will.

But, as a practical matter, we have advised our correspondents that no such change threatens at present. Atomic power is still a dream and a hope, not a reality. There will be, undoubtedly, ample warning of any really useful or revolutionary development of it. Investment values in present power-producing plants and in franchises dependent on power production by present methods are not threatened in the least by any discovery which can now be foreseen.

Large Power Units

WHILE we are on this question of power, investors should be alive to the fact that the trend of power-producing development is steadily toward the growth of large generating units as against small ones. The individual steam or electric generator plant is giving way to the use of electric motors supplied with central-station power. The small central station, as, for example, in small towns or sections of cities, is giving way to the large generating station situated more favorably for fuel supply, natural power or for some other factor.

There are two reasons for this—scientific reasons. One is the increased efficiency of the large-scale steam and electric machinery. The other lies in the improved methods for transmitting electric current over long distances with safety to the public and with little loss of the energy. The result is the gradual consolidation and linkage of power plants which has been going on for some ten years and which is culminating rapidly in the super-power plans now proposed or under way in various parts of the country. The ultimate stage will probably be the generation of electricity at a relatively few great central stations, situated at the water-power sites and at the coal mines.

What does this mean financially? Most immediately, it means that investments in small, local power-producing enterprises are not—other things equal—good investments. Their value is likely to decrease rather than to increase.

A Caution

SINCE this is the first month of this department I had better pause to emphasize three words in the preceding paragraph—"other things equal." It is no part of our plan for this department that we should give specific advice about individual power plants or individual securities. That is the business of your banker. Even if it were not his business, we could not advise you intelligently about an individual case without a full special study of that case.

What we do is to give you the broad facts. The broad fact is that small electric (or steam) power plants are on the decrease. Large plants are on the increase. *In general*, it is good policy to put your money into large power enterprises rather than into small. There may be exceptions. You must judge those exceptions for yourself.

But unless you know definitely that a specific investment which you are considering is an exception, it is wiser, we believe, to follow the general rule.

Radio Stocks

ANOTHER industry which shows, at present, a pronounced general change is the radio industry. The change is toward the sale of complete radio sets and away from the sale (to the public) of the instruments, panels and other parts of which radio sets may be built by the home radio constructor.

During the past few months a number of radio stocks have been unusually active. We do not believe that this activity, in itself, means much. It is probably merely a symptom of uncertainty in the radio industry. During an uncertain condition some men are optimists, others are pessimists. These are the ingredients for a fluctuating market.

The basic facts of the radio industry are: (1) the curiosity interest in radio has worn

off; (2) broadcasting has improved—although it is still very unsatisfactory—and many persons are turning to radio more and more for entertainment of the theatrical type; (3) the radio set has won a place in the average American home; it is something that "you have to have," like good-looking furniture or enough dishes to go around.

These facts mean set buying, not set building. The same conclusion comes to us from all other data that we can collect, including a canvas of a number of radio retailers. There are still the enthusiasts who buy parts and build their own sets. There always will be, just as there are women who put up canned vegetables at home or men who enjoy fixing broken furniture for themselves. But most people are buying the ready-for-use, factory-made radio sets.

The financial meaning of this is clear. The best radio investments are in the securities of those companies which are well established in the set-manufacturing business or which are producing exceptionally good sets and bid fair to be well established in that branch of the business within a reasonable time. Conversely, the securities of companies engaged in selling radio parts to the public (rather than to set manufacturers) should have severe scrutiny to determine just what business such companies will have left after the public has deserted entirely from the set-building army.

Questions

THE preceding columns—if you have read so far—will have shown you something of what we are trying to do with this department. If some question of basic scientific fact is bothering your own financial program, send the question along to us. We will try to answer it, either in this column or by mail. But remember that we cannot answer questions about individual companies, securities or investments. Ask these questions of your banker. Our job is to tell you what we can of the scientific possibilities or impossibilities, of the general trends and prospects of industry and discovery.

The Heavens in April

By Professor Henry Norris Russell, Ph.D.

At 11 o'clock: Apr. 7.
At 10½ o'clock: Apr. 14.
At 10 o'clock: Apr. 22.
At 9½ o'clock: April 30.
At 9 o'clock: May 7.
At 8½ o'clock: May 15.
At 8 o'clock: May 23.

The hours given are in Eastern Standard Time. When local summer time is in effect, they must be made one hour later: 12 o'clock on April 7, etc.

NIGHT SKY: APRIL AND MAY

The Heavens

THE splendid constellations of winter are nearly gone now—only Auriga, Gemini and Canis Minor lingering in the west and northwest. Leo is high in the west and Virgo in the south. Hydra stretches all along the southwest and south below them. Scorpio and Ophiuchus are rising in the southeast. Libra, above the former, is brightened by the presence of Saturn. Bootes is high in the east with Corona, Hercules and Lyra successively lower and to the left. Ursa Major is high overhead, with Draco and Ursa Minor below, and Cassiopeia and Cepheus skimming the horizon.

The Planets

Mercury is an evening star until the 18th and a morning star afterwards, but is practically invisible except in the twilight at the very beginning of the month. Venus, too, is in conjunction with the sun, on the 25th, changing from a morning to an evening star, and is practically invisible.

Mars is an evening star in Taurus, and is so far north that he remains in sight till nearly 11 P.M. He has lost most of his light—being nearly 200 million miles away—and looks only about half as bright as Aldebaran.

Jupiter is in Sagittarius and comes into quadrature west of the sun on the 11th. Being very far south, he rises at 1:30 A.M. Saturn is in Libra, approaching opposition, and rises at 8 P.M. in the middle of the month. Uranus is in Pisces, unobservable except just before dawn, while Neptune is in Leo, and crosses the meridian at 8 P.M.

The moon is in her first quarter at 3 A.M. on the 1st, full at 11 P.M. on the 8th, in her last quarter at 7 P.M. on the 15th, new at 8 P.M. on the 22nd, and in her first quarter once more at 10 P.M. on the 31st. She is nearest the Earth on the 13th and farthest away on the 1st, and again on the 29th. During the month she passes by Neptune on the 4th, Saturn on the 10th, Jupiter on the 15th, Uranus on the 19th, Mercury on the 22nd, Venus later on the same day and Mars on the 26th.

A New Variety of Cross-Word Puzzle

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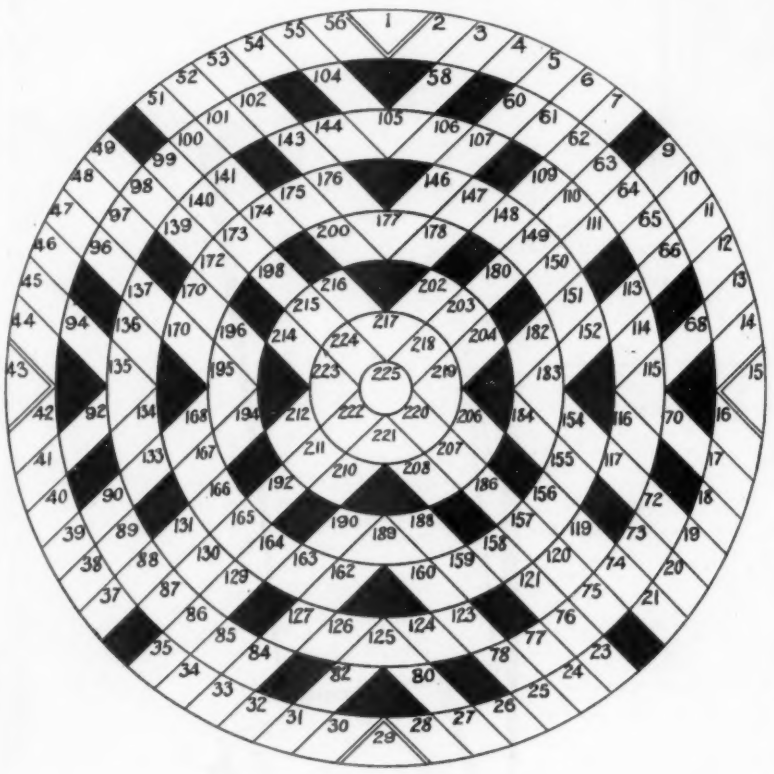
THIS newest wit tester was devised by Mr. Albert Fitch of Central City, Nebraska. Because of its unusual form we have set down, opposite the definitions below, both the initial and the terminal space for each word. That is, the figures "9 to 21" mean that the thirteen letter word meaning "insomnia" stretches from space number 9 around the right-hand side of the puzzle to space number 21, both inclusive.



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It is not necessary to look up the words of the puzzle in the pages of the magazine, as we required last month. Simply send in the solution. If it is correct you will get your one-dollar credit. Solutions must reach us before midnight of April 19, 1925.

Address: Cross-Word Editor
Scientific American
Woolworth Building
New York, N. Y.

CURVILINEARS

9 to 21 Insomnia.
35 to 23 Expenditures.
49 to 37 A kind of coat.
51 to 7 Deferrings.
60 to 66 Beatific.
78 to 72 Apprehends.
90 to 84 Very hard.
96 to 102 A species of an American wild animal.
109 to 111 A man's name.
113 to 117 A Missourian county seat.
121 to 119 A form of water.
127 to 123 To rub out.
131 to 129 A small rodent.
137 to 133 A soldier's dress.
139 to 141 To be sick.
143 to 107 To rescind.
146 to 152 Permission.
160 to 154 A bed of a stream.
168 to 162 Certain periodical winds.
170 to 176 An obstacle.
182 to 184 A nickname.
190 to 188 Also.
196 to 194 A point of the compass (abbr.)
200 to 178 A border.
202 to 204 Sick.
208 to 206 To attempt.
212 to 210 An enclosure.
214 to 216 A firearm.
221 (to left) To make her jump (two words).

RECTILINEARS

31 to 125 A great country (abbr.)
33 to 189 A prefix, signifying narrow.
34 to 85 A preposition.
37 to 166 To venture.
38 to 89 A man's nickname.
39 to 195 Tutelary gods.
41 to 135 Purpose.
45 to 135 To beat (colloq.).
47 to 195 Desert rovers.
48 to 97 Part of a continent (abbr.).
49 to 172 Left by a wound.
51 to 174 A Neapolitan educator.
52 to 101 A beautiful Hawaiian bird.
53 to 177 A trap.
55 to 105 A receptacle.
61 to 6 A military abbreviation.
65 to 10 A man's nickname.
73 to 20 Till sale (abbr.).
77 to 24 Dexter (abbr.).
87 to 63 Dominance.
99 to 75 Circular border.
105 to 3 Name (French).
115 to 13 To drink with the tongue.
115 to 17 A grocer's abbreviation (plural).
125 to 27 Part of the body.
148 to 7 Low, sandy islets (variant).
150 to 9 A kind of worm.
156 to 21 A promontory.
158 to 23 Melodies.
163 to 190 A preposition.
167 to 194 A chemical symbol.
171 to 196 A diphthong.
175 to 200 What? (ejaculation).
177 to 5 A girl's name.
178 to 147 A note of the scale.
182 to 151 Like.
183 to 11 A Swiss city.
183 to 19 Pleasure sated.
184 to 155 A college degree (abbr.).
188 to 159 An exclamation.
189 to 25 A large body of water.

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1924 Campaign in SCIENTIFIC AMERICAN

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Notes and Queries

Conducted by Albert A. Hopkins

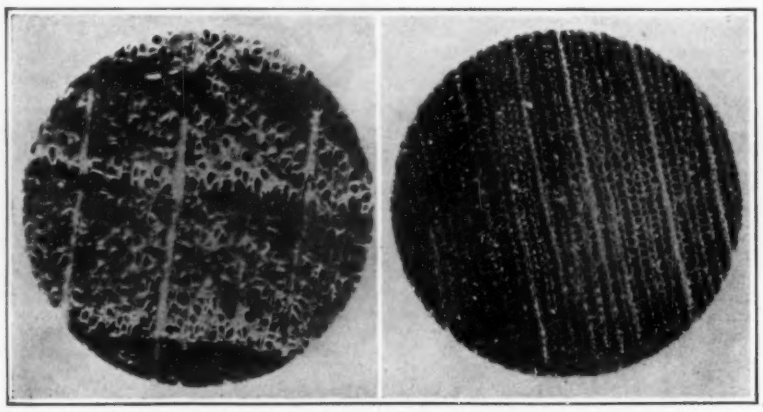
This department is intended for queries of general interest. Only a small percentage of the queries we receive can be printed here, the great majority being answered by mail. Except in special cases we cannot solve mathematical problems, give directions for building machinery or answer queries of a special nature which belong within the sphere of the professional engineer. All queries must give the name and address of the inquirer and must be accompanied by return postage. In writing about book orders or subscriptions please use separate sheets, give your name and address on each.

How Paint Preserves Wood

R. L. M. *asks how paint lengthens the life of wood.*

ANSWER: When timber is cut, milled into lumber, and erected into structures such as dwellings, its durability is dependent upon protective coatings. If left bare, shrinking, swelling and internal stresses take place, which cause warping and checking, due to absorption of moisture and subsequent evaporation of the moisture. Under such conditions, wood destroying fungi may rapidly enter the wood and gradual decay and rotting will take place.

The honeycomb structure of wood is responsible for the very rapid absorption and subsequent drying out of bare wood. The fibrous part rapidly takes up moisture, and when it becomes saturated, further quantities may be admitted in liquid form between the cells. This water will be held in the cellular cavities of the wood, and swelling will take place. When stacked and dried, both the water in the cells and the moisture in the fibre may pass out and the wood be restored to its normal, so-called air dry form. For example, under normal conditions of testing and fabrication, a wood like spruce should contain in the neighborhood of eleven to fifteen percent of moisture.



Typical wood cross-sections, showing honeycomb structure that causes rapid absorption of water if not painted

If this absorption of moisture or water can be so retarded that only small amounts are taken up, the volume changes that take place in the wood can be minimized and warping and checking will not be disclosed. This is exactly the function of paint coatings. They do not entirely prevent the absorption of moisture, but the amount that passes through a well designed coating is so small as to be a negligible factor. This was indicated in some tests made on a number of spruce panels coated and uncoated, which were placed in a cabinet saturated with moisture at a temperature of 100 degrees, Fahrenheit, for a period of seven days. It was found that the bare wood had taken up over seven ounces of moisture per square yard, whereas the wood coated with a high grade enamel took up as low as 0.1 ounce per square yard.

In view of the fact that practically all woods used in building construction contain a definite amount of water even in the original so-called "air dry" form in which they are generally used, it can readily be seen that a coating applied to such wood, which would not allow even slight changes in the moisture content, might be inadvisable. The paint should be of such a nature as to take care of a slight "breathing" action to afford the best results.

One of the main functions, however, of paint and varnish is the protection of wood against the entrance of wood destroying fungi, by forming an almost impermeable seal against such fungi. While fungi may occasionally grow upon some soft coatings rich in oil, and exposed in damp, warm places, such fungi cannot, under normal conditions, gain admittance to the wood through these coatings, and thus the wood is protected.

If wood is placed unprotected in damp soil and only the exposed part is painted, decay may take place in some instances in the same way as it would slowly occur on water-soaked shingles, the surfaces of which had been painted. These, however, are unusual and abnormal conditions and may be guarded against. The timber engineer is constantly carrying on researches on methods of protecting wood by impregnating it with toxic salts. Ninety-five percent of the lumber used in our homes, however, still depends upon paint for its protection and beautification.—Henry A. Gardner, Director, Institute of Paint and Varnish Research, Washington, D. C.

The Weight of the World in the General Science Class

Miss M. F. *asks for information as to the weight of the world. The question came in her general science class. To correct certain errors we offer the following:*

ANSWER: The total mass of the earth is 5,000,000,000,000,000,000,000 tons. It is not correct, however, to speak of the *weight* of the earth. To a scientist the expression would be meaningless. This is a little difficult to explain clearly.

When you speak of the weight of a thing you mean the amount of attractive force that the earth has for it. Since that is so, how could the earth have weight? In other words, how could the earth attract the earth?

Only in attempting to get a clear idea of how much matter there is in the earth we might be permitted to say it weighs the number of tons named above, although this would not be a scientific expression.

Here, perhaps, is an easier way to think of it without being unscientific: If you could shovel the whole earth into a wagon, load by load, and weigh each load before dumping it and loading on another load, then the sum of

the weight of all of your loads would give a weight of 5,000,000,000,000,000,000,000 tons.

Another way to see the distinction between weight and mass would be to imagine a globe of rock, say as large as the globes used in schools, millions of miles out in space between the stars. It would have no weight for there is nothing there to attract it the way the earth attracts things put on scales. But it would have mass, as you would soon find if it were moving through space and you got in its way.

The earth may be thought of just as that globe was. It is a load of matter in space; it cannot be said to have weight, but its mass is 5,000,000,000,000,000,000,000 tons.

If your class has a physics book it will tell you just about the same thing, but if you are not able to see the distinction clearly, remember that many people have the same trouble. Some never succeed.

Cartwheels to the Fore

G. N. J. asks: "*Why did the government recommend silver dollars as a gift this past Christmas?*"

ANSWER: Use of the new, uncirculated 1924 silver Peace Dollar by people giving money as gifts was urged by the Treasury in its plan to reestablish the circulation of such coins.

Lack of linen rags is behind the request. Printing of 200,000,000 Liberty bonds and increased demand for currency during the war period and after the armistice used all reserve stocks of linen money paper.

Manufacturers are unable to obtain linen rags to make more and have been forced from a 100 percent linen basis to a 100 percent cotton basis. They also have been compelled to omit the sizing process and have cut the time of manufacture from three months to three weeks, with the result that unseasoned paper currency of much shorter life has been turned out.

It costs the government 1.6 cents to make a one dollar bill and keep it in circulation.

In view of the very poor quality of currency now out, the Treasury desires to put in circulation about 40,000,000 silver dollars to replace one month's supply of paper dollars. If that can be done, it is estimated an annual saving of about $1,000,000 can be effected.

Making Arrow Heads

I. V. J. *wants to know how to make arrow heads. It is true that genuine Indian arrow heads can be purchased at a low price, still some of our readers might be interested in knowing how they can be made. Great practice, however, is required to produce a satisfactory imitation of the genuine Indian product.*

Cushing's account follows:

ANSWER: The Indians first sought the material, mined it arduously from buried ledges with fire, mauls, and skids, or preferably, when the country afforded, sought it in banks of bowlder pebbles. They dug such as were fit freshly from the soil, if possible, and at once blocked out from them, blanks for their blades by splitting the pebbles into suitable spalls, not by free-handed percussion, but by holding them edgewise on a hard base and hitting them sharply and almost directly on the peripheries, with a one-sided twist or turn of the maul or battering-stone.

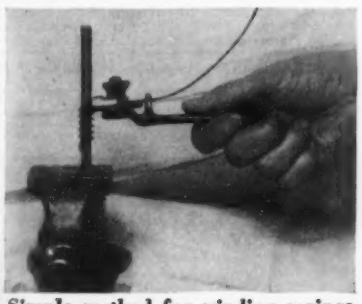
The spalls, sometimes twenty from a single cobble or block of moderate size, were trimmed with almost incredible rapidity to the leaf-shape basis of all primitive chipped tools by knapping them with a horn, bone, or very soft, tough, granular stone hammer mounted in a light handle. For this the spall was placed flatwise on the knee or on a padded hammer-stone, so called, and held down by the base of the thumb of one hand and rapidly struck along the edge transversely and obliquely to its axis lengthwise, with the outwardly twisting kind of blows used in the splitting.

The blanks thus formed were then carried home for leisurely or opportune finishing, and carefully buried in damp soil, not to hide them, as has been usually supposed, but to keep them even-tempered or uniformly saturated ("full of sap and life" these ancients thought); whence the so-called "caches" of numerous leaf-shape blades which are now

and then found, for example, throughout old Indian ranges.

In finally forming arrow points from these trimmed blanks, the smallest of them only were chosen. The first care in fashioning one of these was to remove protuberant points from its edge and sides and to thin it down by means of a pitching-tool of buckhorn. This was effected in several ways, usually by clamping it in a folded pad of buckskin under the knee against a hammerstone (anvilstone) or notched wooden block, so that the projecting edge rested over the margin or else over the pit of the stone, or notch if a block or log were used, and with one hand holding the point of the pitching tool very lightly and slantingly and at a wide angle against or just over the points to be chipped, sharply tapping the tool with a maul or with a knapping hammer. Thus the blade was quickly thinned down and made almost even edged.

It was now further shaped, sharpened, notched, barbed or serrated, according to intended use, and tanged with a rounded, flat bodkin or horn (seized to a stick or handle for leverage at one end and tapering therefrom to a curved, blunt point), either by laying it on a folded buckskin, over the hollow of a hammer-stone or the palm of the left hand, pressing it downward along the edges at nearly right angles, and always slantingly to its length, or else holding its edge up between the thumb and all the fingers of the left hand and freely flaking it with the rod held in the right hand, with hand braced against the ribs for steadying, by pressing the sharp edges until they caught in the point or blade of the bodkin, and twistingly wrenching them off by a most dexterous motion, which can be exhibited, but not adequately described or illustrated.



Simple method for winding springs on a small scale

Simple Spring Winding

H. J. P. *asks for a simple way to make a spiral spring.*

ANSWER: Winding an ordinary spiral spring in the absence of expensive machinery for winding large quantities of springs is not easy to do with accuracy. With the aid of a vise, a metal core corresponding to the desired internal diameter of the helix, and a special winding tool of low cost, however, the trick is quickly turned. The core is fixed in the vise; and the wire of the spring-to-be is curled around it with the utmost neatness and despatch. The little detail of holding the loose end while the winding gets started is taken care of, and one may be sure of getting the spring of exactly the proper size and of uniform curvature and tension in each of its turns.

Antiquity of Signaling

M. M. K. *asks for information as to the antiquity of signaling.*

ANSWER: The fabulous honor of being the first inventor of the art of signaling is bestowed by certain classical writers upon the ingenious Palamedes, but it is certain that, long before the time of the Trojan war, the Egyptians and Assyrians, if not the Chinese and other nations of remote antiquity—of whom monumental records alone remain to us—had developed regular methods of signaling by fire, smoke, flags, and so on. Signals were passed from tower to tower of the great wall of China, and the tower of Babel was a signal tower.

Beacons are "as old as the hills" on whose summits they were placed. Those lighted on Mounts Ida, Athos, Cithæron, and intervening heights, conveyed information of the taking of Troy by Agamemnon. Leander was guided across the Hellespont by the signal lamp displayed by Hero in her tower at Sestos. One night the lamp was blown out—he was drowned, and she then threw herself into the waves. Theseus, in the Argonautic expedition, conveyed information by colors of the sails hoisted, but killed his father through a telegraphic error; for, flushed with victory, he forgot his signal, and old Ægeus, seeing the black sail, and feeling sure his son was dead, flung himself into the sea.

The use of mirrors to flash signals by the sun's rays dates back to the time of the Pharaohs. The Persians are said to have considerably developed it for purposes of war.

The Persians, the Gauls, and the Aztecs communicated by relays of sentinels shouting to one another, and Alexander, by means of the stentorophonic tube, conveyed his orders for four leagues.

The tactician Arnios communicated at night by means of a tall vessel containing water, which was let out slowly by a tap at the bottom; on the water floated a cork disk carrying a gage with divisions down the side, and on each division a separate sentence was inscribed. Each signaling point had one of these contrivances; and on a light being shown from one station it was acknowledged by the other, and each clepsydra opened at the moment. When the surface of the water receded to the sentence required, the signaling station again showed a light, when the other stopped the outflow and read the words inscribed at the water level upon the corresponding gage.

Hannibal erected watch towers in Africa and Spain to signal from; and whenever the Romans extended their conquests in Gaul, Spain or elsewhere, they made use of similar signaling devices. A representation of one of their telegraph towers is engraved on Trajan's Column, and ruins of some of them are still to be seen in parts of France.

How to Tell the Polarity of Your Batteries

F. J. W. *asks how to tell a battery's polarity.*

ANSWER: Many radio fans are unable to tell which of the wires leading from their batteries are negative and which are positive. Here is a very simple way to do it: Add a little common table salt to a glass of water, place the ends of the wire into the solution and always there will be a bubbling around the negative wire, while the positive wire will cause no disturbance.

Photo Kadel and Herbert

Holding the wires in the salt solution to determine polarity

Power of Windmills

R. P. R. *asks for some information relative to the power of windmills at different velocities of the wind.*

ANSWER:

Velocity of wind— Miles per hour.....	5	10	15	20	25
Size of Wheel					
Eight feet	0.011	0.088	0.297	0.704	1.375
Twelve feet	0.025	0.20	0.675	1.6	3.125
Sixteen feet	0.045	0.36	1.215	2.88	5.52

These figures have been proved by laboratory tests at velocities ranging from ten to twenty-five miles per hour and more. It has been found that windmills do not work as efficiently in high winds as in winds under twenty miles an hour.

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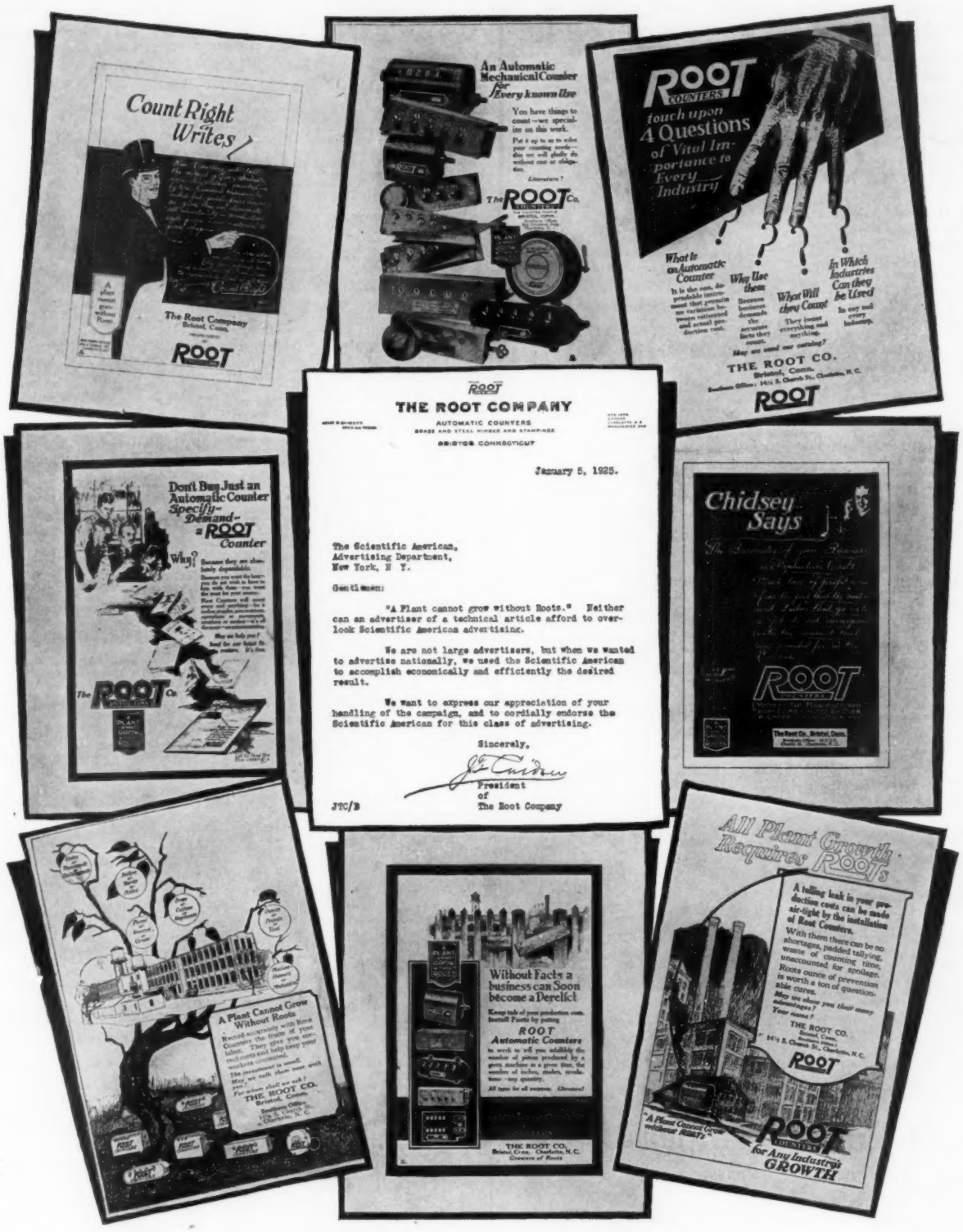

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1924 Campaign in SCIENTIFIC AMERICAN

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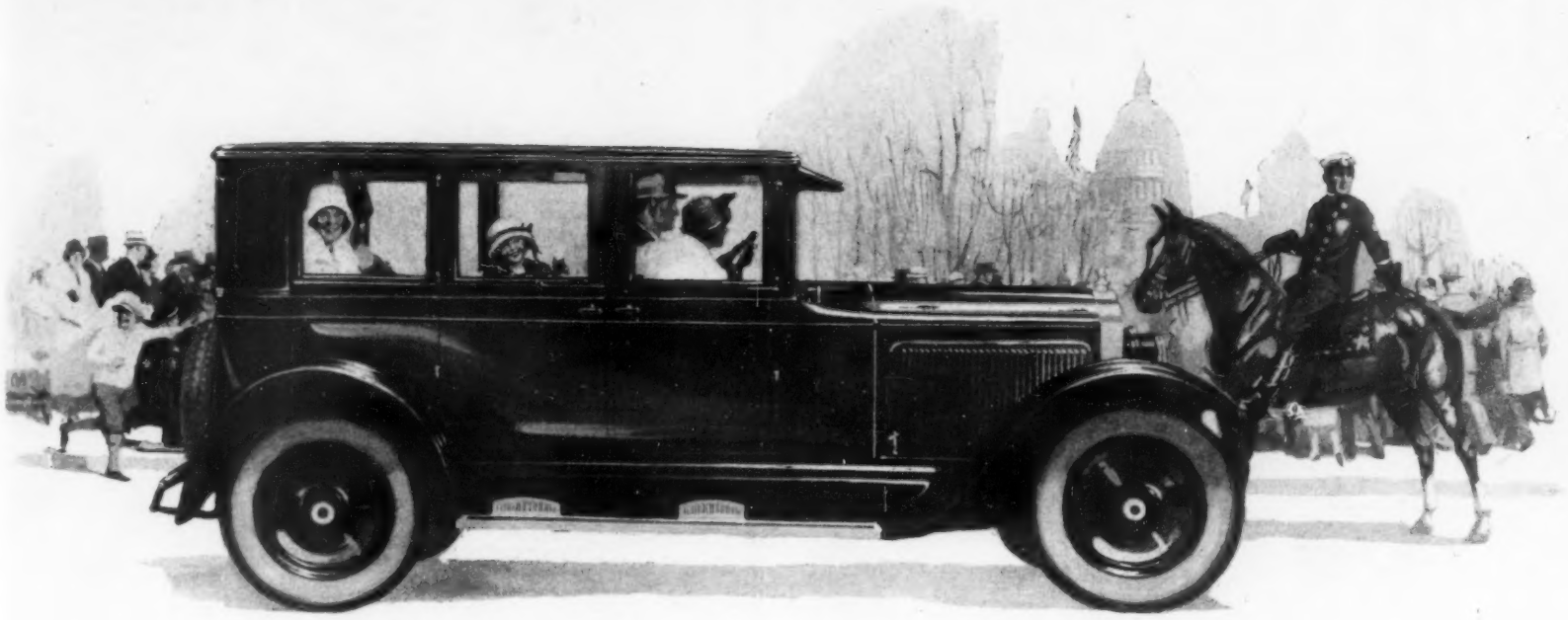


The *success* of the new Willys-Knight assumes the proportions of a *great* national welcome

There is a great and very definite national movement toward Willys-Knight—the motor car that *owners can keep*, want to keep and *do keep* for years and years.

The Willys-Knight sleeve-valve engine is the *only* type of internal combustion engine that actually *improves with use!* This engine stays young because all moving parts move with a *sliding* or *rotary* motion—whereas poppet-valve engines have clashing parts in constant concussion . . . This engine does not choke up with carbon—whereas poppet-valve engines do choke up with carbon . . . This engine *never* needs valve-grinding—whereas poppet-valves do need grinding . . . Quiet in the beginning, this engine is even quieter after thousands of miles of driving—whereas poppet-valve engines grow noisier . . . This engine *gains* power with age—poppet-valve engines *lose* power with age!

The new Willys-Knight is the *only* car in the United States that is equipped with the great Lanchester Balancer—the celebrated invention which enables Willys-Knight to introduce to the motorists of this country the joys of *vibrationless* motoring. No vibration at any engine speed!

Dr. Lee de Forest, the "father" of radio; Glenn Curtiss, the aeroplane inventor; Hiram P. Maxim, President of the Maxim Silencer Company; Franklin D. Roosevelt, formerly Assistant Secretary of the U. S. Navy—scores of prominent Americans, after riding in the new Willys-Knight, have voiced their highest praise of this car's remarkable smoothness—its quietness—its nimble getaway—its great sufficiency of sustained power. Look into this car.

WILLYS-OVERLAND, Inc., Toledo, Ohio
Willys-Overland Sales Co. Ltd., Toronto, Canada

The Sedan Reduced $200

New WILLYS-KNIGHT

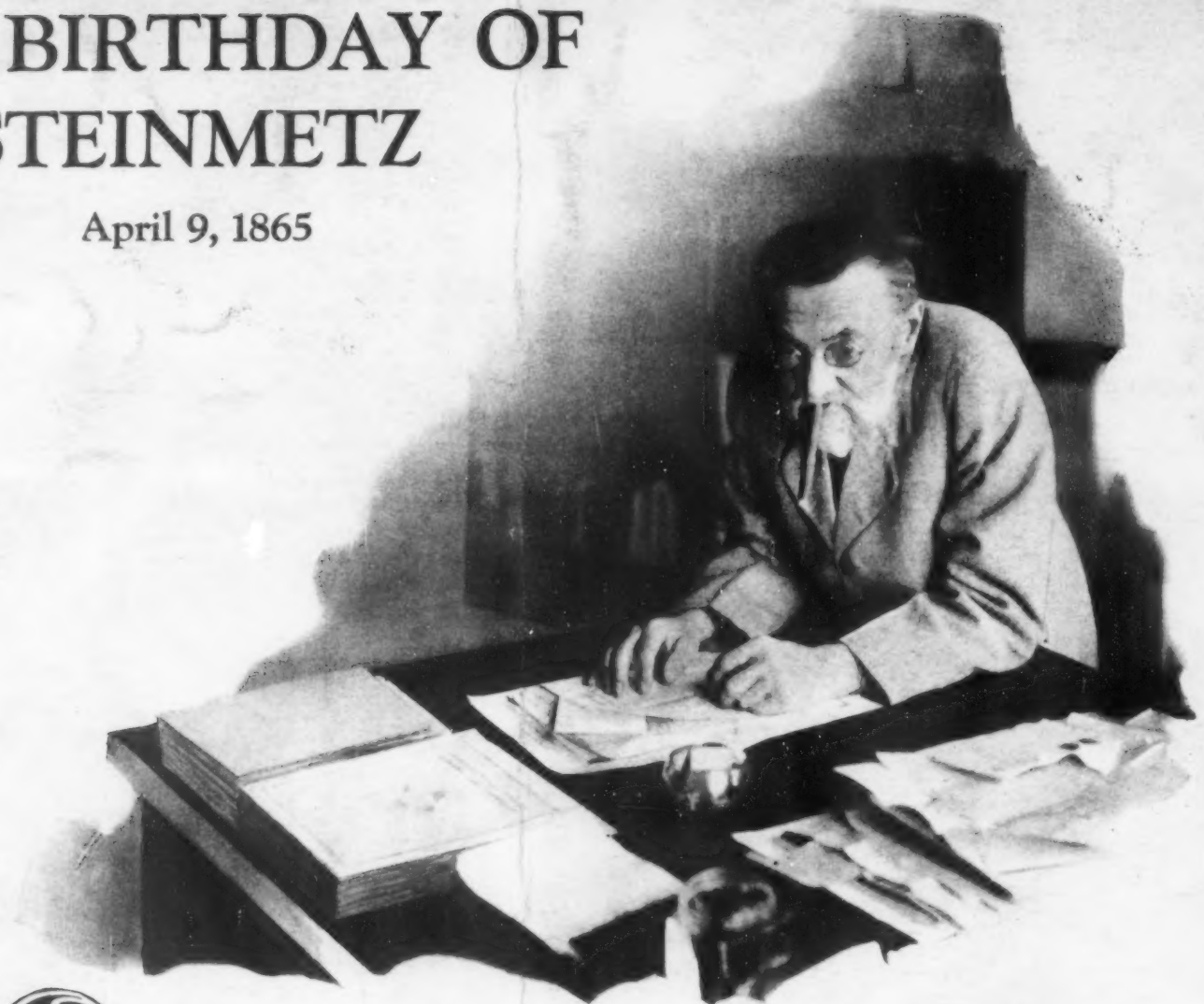
With an Engine you will never wear out

WILLYS-OVERLAND, INC., *have our endorsement. In dealing with them please mention* SCIENTIFIC AMERICAN.

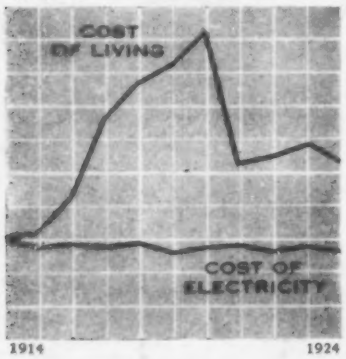
Printed in the United States, by ANDREW H. KELLOGG CO.

THE BIRTHDAY OF STEINMETZ

April 9, 1865



Dr. Steinmetz did his great work in the General Electric laboratories in the years between 1893 and 1923. He contributed in large measure to the service of your Electric Light and Power Company—a service so efficient that electric current is one of the very few products that actually cost less today than before the war.



ON April 9, 1865, he was born in Breslau. On June 3, 1889, he landed in New York City from the steerage—in debt for his passage and unable to speak our language.

Twelve years later he was elected president of the American Institute of Electrical Engineers. President Eliot of Harvard proclaimed him the foremost electrical engineer in the world.

On October 26, 1923, he died.

Did ever a few brief years witness more miracles? When his life began, there was not a single electric light and power company. When it ended, there were 6,000 in America, serving more than 11,000,000 homes.

Physically frail himself, he helped to make electricity the great lifter of burdens; by his courage and vision he was an inspiration to the whole electrical industry.

Such a man deserves to be remembered on his birthday, not on the day of his death. For in the larger sense he does not die. Humanity is permanently richer because of what he gave.

GENERAL ELECTRIC

92-37